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AND

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Errata in Kent's "Pocket Book"—A History of Engineering—Notes and Queries.

Several express locomotives have recently been built for the fast mail service of the Chicago & Northwestern Ry. by the Schenectady Locomotive Works, of Schenectady, N. Y. They are of the eight-wheel type, and the principal dimensions are given below. Brakes are fitted to the engine truck, driving wheels and tender trucks:

Driving wheels, diameter	6 ft. 3 ins.
Driving wheelbase	8 " 6 "
Weight on driving wheels	78,000 lbs.
Weight of engine	125,600 "
Weight of engine and tender	218,000 "
Cylinders	19 x 24 ins.
Boiler, diameter	5 ft. 2 ins.
Boiler pressure	190 lbs.
Firebox	8 ft. x 3 ft. 4 ins.
Tubes, number, 287; length	11 ft. 6 ins.
Heating surface	1,938 sq. ft.
Capacity of tank	4,800 gallons.
Capacity of coal space	8 tons.

The report of the Railroad and Warehouse Commission of Minnesota shows that on June 30, 1895, the state had 5,990 miles of railway, of which 39 miles were built during the year. The operating expenses amounted to 55.82% of the gross earnings, as against 59.04% for the previous year. The average rate per ton per mile was 1.089 cts., and the average receipts per ton, $1.24. The average rate per passenger per mile was 2.46 cts.

The change of line of the Boston, Revere Beach & Lynn R. R., at Revere, Mass., which is made necessary by the operations of the Metropolitan Park Commission, of Boston, will, it is said, be an elevated line near the beach, at the edge of the new park. It will be an earth embankment, with iron bridges over all roads, the object being to avoid grade crossings.

The Ruth patent sleeping car berths, which are collapsible, and are inflated by air from the brake pipe at night, are to be fitted in the private car of Mr. J. H. Reed, Vice-President of the Pittsburg & Lake Erie R. R.

The plans for abolishing the grade crossings of the Boston & Albany R. R., at Newton, Mass., provide for lowering the tracks and carrying streets across by 17 bridges.

A decision in a suit involving the rentals for the use of a union station has been rendered by the Supreme Court of Missouri. The suit was brought by the St. Joseph Union Depot Co., of St. Joseph, Mo., against the Chicago, Rock Island & Pacific Ry. Co. A summary of the case is as follows:

The Chicago & Iowa R. R. and Chicago, Kansas & Nebraska Ry. companies made a contract at the same time with the union depot company, whereby each company agreed to pay a rental for the use of the depot "for all its passenger trains destined to or departing from the city." Prior to the contracts the C. & I. company had leased the line of the C., K. & N. company, and after the execution of the contracts, conveyed to the defendant (the C., R. I. & P. Ry. Co.), who had no contract with plaintiff for the use of the depot, its line, together with all leases and privileges. The rentals provided for in the contracts with each of the companies were paid either directly or indirectly by the defendant for several years. The court held that the C., R. I. & P. Ry. Co. was not entitled to use the depot for both the C. & I. and C., K. & N. lines on payment only of the rental provided in the contract with the C. & I. company.

Where defendant uses the depot for the C., K. & N. line, it is liable for the rent provided for in the contract with that company.

The fact that defendant purchased the C., K. & N. line under foreclosure of a mortgage executed prior to the contract with plaintiff does not affect its liability for the payment of the rent if it uses the depot for the C., K. & N. line trains.

A correspondent who sends us the above says that a motion for a re-hearing was set aside in the case. It is different from that of the Kansas City Union Depot case, in the fact that at Kansas City the C. & I. and C., K. & N. roads were tenants at will, while at St. Joseph they had a 50-year lease.

The most serious railway accident of the week was a head collision between two local passenger trains, Dec. 21, at Frankford (a suburb of Philadelphia, Pa.), on the Philadelphia & Reading R. R. A train for Philadelphia should have waited for one from the city, but was started in disregard of train orders. Two men were killed and seven injured, all of these being in the smoking and baggage car of the train for the city. The engineman and firemen jumped, and the conductor of the latter train ran away. A head collision occurred, Dec. 20, on the Adirondack & St. Lawrence R. R., near Horseshoe Pond, N. Y., between a passenger train for Montreal and a light engine which was trying to reach the sidetrack at Horseshoe Pond. The engineman of the passenger train was killed, and the engineman of the light engine seriously injured. A misplaced switch at Milton Center, O., on the Cincinnati, Hamilton & Dayton R. R., caused a passenger train to run into a freight train on the sidetrack, Dec. 16. Several persons were in the caboose of the freight train, and one was killed, while six were more or less injured.

Two electrical locomotives are being built by the Baldwin Locomotive Works, of Philadelphia, Pa., not for order, but largely as an experiment, under the Baldwin-Westinghouse combination. They are intended for passenger service.

A cable railway line to the top of the volcano of Popocatapti has been surveyed, says a Mexican news item. The summit of the mountain is about 18,000 ft. above sea-level, and the railway, if constructed, would be used both for tourists and for the carriage of sulphur obtained from the crater. At its base the cable line would connect with the Inter-Oceanic Railway. The same item says that the canal for draining the valley of the City of Mexico is now virtually completed, the remaining work being upon the slopes, which require some trimming. This canal is about six miles long, and the total excavation is given as about 14,000,000 cu. yds.

The Brooklyn Bridge report for the year ending Dec. 1, 1895, may be briefly summarized as follows:

Receipts from tolls		$1,224,272.86
" " all sources		$1,626,578.04
" " carriageways	$93,664.02	
" " railway	1,130,608.84	
Passengers carried by railway, 1895		44,564,329
" " " " 1894		41,714,235
Expenditures, maintenance & construction		$1,647,316.56
" on construction		247,263.73

The report states that reduction in the price of tickets, ordered July 1, 1894, by which two tickets are sold for 5 cts., does not seem to have had any effect upon the number of passengers carried by the railway, but has reduced the revenue about 7%. In the 12 3-16 years that the bridge has been in service the railway has carried 391,153,850 passengers, with but two fatal accidents up to the date of the report. A better system of signaling in dense fogs is being sought for.

The case of the new East River bridge vs. the Uhlmann charter seems likely to be adjusted on the basis of a payment of $200,000 to Mr. Uhlmann for his franchise by the bridge commissioners.

The combined capacity of the pumps in the Ellicott Square Building, Buffalo, described in our issue of Dec. 5, is reported as nearly 9,000,000 gallons a day. A pump with a capacity of 4,000,000 gallons, when working against 125 lbs. pressure, will be used as the main source of power for the elevators, and a number of smaller ones for various purposes will be employed.

The perfected Maxim rapid-fire gun, lately sent from England to the Ordnance Department in Washington, for test, weighs only 127 lbs., and its inventor claims that it can be fired at the rate of 10 shots per second. It is a single-barrel automatic gun with water-jacket and the ammunition is fed by a belt. It is said to be one of the lightest but most destructive weapons of its class ever made.

Plank sidewalks are to be abandoned in Kansas City, on account of the number of damage suits arising from defects in said sidewalks. The work will be done gradually as the streets are repaired. There are now about 281 miles of these sidewalks, and the cost is given by the city engineer as 23 cts. per running ft. (5 ft. wide), as against 40 cts. for brick.

Chert roads have been largely used in Montgomery county, Ala., but it has now been decided to use clean gravel, which costs much less, and is said to be equally good. The gravel roads are about 9 ins. thick.

The North-German Lloyd Steamship Co. has contracted for six new twin-screw steamers. Two of these are being built at Stettin and at Dantzig, and each of these vessels will be 600 ft. long and 66 ft. beam, and have a speed of 20 knots. The other four will be 525 ft. long, and 64 ft. beam. They are intended for freight, and will have a speed of 14 knots. These latter vessels will, however, have accommodations for 200 first-class and 1,500 steerage passengers, when needed for this service. The Hamburg-American Line, besides building the mammoth twin-screw steamer "Pennsylvania," has contracted for five other twin-screw vessels, to be delivered in 1896. Three of these are being built by Harland & Wolff, at Belfast, including the "Pennsylvania," and the other three are under construction in the yards of the Palmer Shipbuilding Co., at Yarrow. The general tendency now is to build vessels intended to carry large quantities of freight in addition to the passengers. The 21-knot flyers of the "Lucania" and "Campania" type, with all their space devoted to passenger traffic, do not pay.

The bill for the relief of Engineer officers of the U. S. Navy, introduced into the U. S. Senate by Mr. Squire, was prepared by Engineer-in-Chief Melville, and has the approval of the Navy Department and the entire Engineer corps. The bill provides for the increase of the corps to 300 commissioned officers, who are to have the rank and titles of the line officers, and to have absolute command, under the authority of the captain of the ship, of the men in their own department. The Chief of the Bureau of Steam Engineering is to be called the Naval Director-General of Engineering, with the rank of a Rear Admiral, and he is to have two Assistant Inspector-Generals, with rank of Commodore. The bill proposes, also, to establish a course of marine engineering by the authorities of the leading technical institutions of the country; graduates from these schools are to be sent to sea and to some post-graduate institution, and there to undergo examination, in competition with graduates from the Naval Academy, for commissions. It is also proposed to increase the number of cadets in the Engineering Department of the Naval Academy by giving the appointment of such cadets to the Senators, Delegates from the territories, and four to the President of the United States. As each Senator would have one appointment in four years, this method would give a class of 24 engineer cadets each year.

Concerning the method of pumping melted sulphur from the sulphur mine at Lake Charles, La., which it was stated in our issue of Oct. 17 had been successfully tried, a statement is now going the rounds of the press to the effect that the process is so completely successful that six carloads of sulphur, or 120 tons, are now being daily shipped to market. We are informed, however, on what appears to be good authority that the final success of the operation is still a matter of doubt. The process of extracting the sulphur is described as follows: A 10-in. pipe is first driven through the surface to the sulphur bed, 526 ft. below the earth's surface. A 6-in. pipe is then placed inside of this 10-in. pipe. Water is forced from the boilers at 325° F. down the 10-in. pipe into the sulphur bed. This water liquefies all sulphur with which it comes in contact. The sulphur, being of a greater specific gravity than water, sinks below it, and is then pumped to the surface by a pump which has a capacity of five tons an hour. When the sulphur is pumped up it is delivered into large shallow vats, where it solidifies in a few hours, and is broken by pickaxes into blocks ready for shipment. This sulphur is said to come to the surface at a fraction above 99% pure.

The earliest topographical delineation of old London is the map of Anthony Van den Wyngrede, of 1543, preserved in the Bodleian Library. The next is that of Braun and Hogenberg in their work of 1572-73, entitled "Civitates Orbis Terrarum." John Norden, in 1593, published a view of London and Westminster in his "Speculum Britanniae"; the next view was published in 1616 by Cornelius G. Vyscher, at Amsterdam; and this view is remarkable by its attention to the minute architectural detail of many of the more prominent buildings. The whole map is 7 ft. 1 in. long by 1 ft. 6½ ins. wide, and is printed on four sheets. Hollar, in 1647, published a splendid view of London, from Whitehall to Greenwich, measuring 8 ft. by 1½ ft. William Faithorne engraved Newcourt's survey of London in 1658; and Hollar engraved a view of London after the great fire of 1666. After this event views and maps became more common; but the map of John Ogilby and William Morgan, two sworn surveyors who were officially engaged to plot out the disputed property burned over, is the most accurate of that time. Its engraving is unrivaled, and its accuracy has been so frequently tested that it is now accepted as an undoubted authority in all disputes.

THE MINNEAPOLIS COURT HOUSE ROOF.

We illustrate herewith an unusually handsome view of the ironwork for the roof of the new court house at Minneapolis, Minn., which has been sent us by Rinker & Hoff, Minneapolis, Minn., the contractors for the part of the ironwork shown. In this connection we will call attention to a misunderstanding as to whom the credit for the design and

VIEW OF COURTHOUSE AT MINNEAPOLIS, MINN., SHOWING IRONWORK FOR ROOF.
Rinker & Hoff, Minneapolis, Minn., Contractors.

construction of this roof is due, which seems to have arisen on account of the article published in our issue of July 11, 1895. This article referred to the drawings simply as a design, and made no mention of the actual builders. The conditions, as we understand them, were these: Plans were first asked for the ironwork for part of the roof—viz., that part showing the ironwork covered in the illustration, and the plans of the Gillette-Herzog Mfg. Co. were accepted, and the contract let to that firm. About two years later plans were asked for the remainder posed in the illustration, and the plans of Rinker & Hoff were accepted, and the contract let to that firm, as its bid for the work was the lowest. The plans illustrated in our issue of July 11, 1895, were the designs submitted by the Gillette-Herzog Mfg. Co. for the part of the roof built by Rinker & Hoff, but, as explained above, the bid of Rinker & Hoff for this part of the work being lower than that of the Gillette-Herzog Mfg. Co., the contract was let to Rinker & Hoff. The article had for its prime object a lesson to young designers upon the necessity of seeking uniformity, and thus reducing shop work, in designing complicated roofs, and credit was given to the firm which prepared the plans which we used as an illustration of the point we wished to make. No credit was given to any one for building the roof, and no attention paid to this feature of the work, but we make this explanation so that no injustice may be done through a careless reading of the article in our issue of July 11, 1895.

RECENT DESIGNS IN METAL FENCES FOR RAILWAYS.

The use of wire mesh fencing and metal fence posts is rapidly gaining in favor with railway companies for defining the boundaries of their right of way and protecting the tracks from the encroachment of live stock. This has come about partly by reason of the advantage of metal fencing in durability and resistance to fire, but mostly on account of the reduction in the prices of metal by which a first-class material can be used for fencing without entailing a prohibitive cost when large quantities have to be used. In the accompanying cuts some of the more recent constructions in metal fencing for railways and a number of the special tools used in their construction are illustrated.

Fig. 1 illustrates the International steel post for wire fencing, which is quite extensively used on the Cleveland, Cincinnati, Chicago & St. Louis Ry. This post is made of sheet steel, No. 16 gage, rolled in the form of a cylinder, and when driven into the ground it spreads at the bottom and anchors itself. No post holes are required, the post being driven with a maul by placing a temporary driving cap on its top. After driving, the temporary driving cap is replaced by a permanent cap. A variety of spacings of the wire can be used, since the staple holes are so arranged and constructed that the staples can be put in wherever desired. The illustration shows a common form of anchorage for the end post, and also shows the stretchers in place on the post. In constructing this anchorage it is usual to drive the two end posts about 8 ft. apart, and brace them together stiffly with a 1-in. gas pipe. The anchor wires are attached to the second post, and drawn until the posts tip toward the anchorage about 4

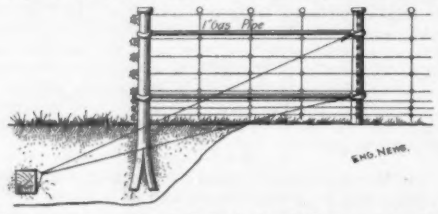


Fig. 1. nternational Rolled Steel Post and Anchor Construction for Railway Fences.
International Steel Post Co., St. Louis, Mo.

ins. at the top. The pull of the fencing will bring the posts to the vertical and take up all the slack in the anchorage. The cost of this fencing depends upon the number of wires and the distance the posts are placed apart. With posts 24 ft. apart and using No. 9 galvanized wire, the cost, as given by the manufacturers, is for a 4-wire fence 46 cts. per rod, a 7-wire fence 58 cts. per rod and a 10-wire fence 70 cts. per rod. The International post is made by the International Steel Post Co., St. Louis, Mo.

Fig. 2 shows several views of the Bond pressed steel post, which is constructed for the attachment of any kind of wire fencing. In constructing this post a wedge-shaped Bessemer steel plate ⅛ in. thick, 7½ ft. long, 4 ins. wide at the top and 6 ins. wide at the bottom is pressed into a V-shape, and the edges are turned out at an angle. Before pressing, the slots for the wires are punched such a distance apart as the kind of fencing to be used calls for. At the bottom of the post two flaps of metal are formed to hold the post in the ground. For the end posts two ordinary posts are riveted together, hollows toward each other, with a web of ⅛-in. steel forming a center diaphragm. The weight of the line posts is 18 lbs., and of the end posts 50 lbs., and they cost f. o. b. at the manufactory 60 cts. and $3.25, respectively. The cost of the end post includes one set of braces and anchorage complete. In setting this post holes have to be dug. This post is made by the Bond Steel Fence Post Co., Adrian, Mich.

Fig. 3 illustrates the Avery pressed steel post for railway fencing. Like the other two posts described, it is made to fit any particular fencing desired by the proper spacing of the staple holes. Post holes have to be dug, and to secure a firm anchorage, prongs are formed near the bottom. For end or corner posts, two line posts are set together, hollows toward each other; and collars carrying pins (Fig. 3, a), are slipped over them. Similar collars are slipped over the adjacent posts, and horizontal gas pipe braces are placed between the corner posts and the posts adjacent by slipping their ends over the pins. Generally three horizontal gas-pipe braces are used, and the posts are tied

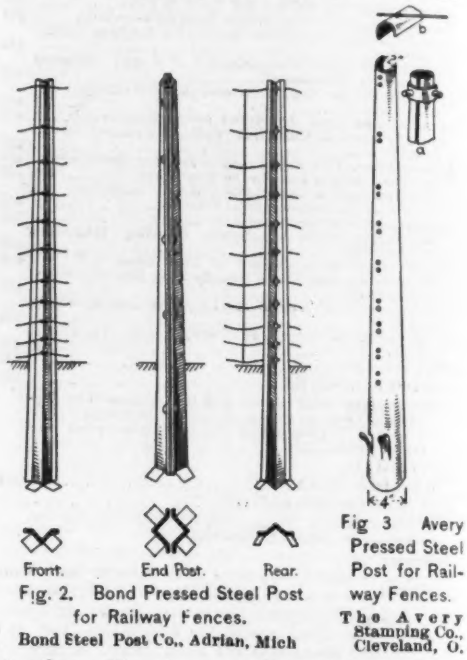


Fig. 2. Bond Pressed Steel Post for Railway Fences.
Bond Steel Post Co., Adrian, Mich

Fig 3 Avery Pressed Steel Post for Railway Fences.
The Avery Stamping Co., Cleveland, O.

together with wires extending diagonally from the top of each post to the bottom of the other. The method of attaching the wires to the post is shown by Fig. 3, b. This post is made by the Avery Stamping Co., Cleveland, O.

Fig. 4 shows the standard railway fence manufactured by the Page Woven Wire Fence Co., of Adrian, Mich., and the special apparatus used for stretching it. The stretcher is clearly explained by the drawing, and is furnished by the company at actual cost price and the amount refunded to the purchaser upon return of the stretcher in good condition. This device is absolutely necessary to the proper erection of the Page fence.

The earlier forms of metal fencing, consisting simply of horizontal wires extending from post to post, were inferior to the mesh fence or fence with vertical ties at frequent intervals which is now commonly used. In many cases where the old style of fence exists, therefore, it is being strengthened by putting in vertical ties at a much less cost than if it were replaced by new fencing. The chief difficulty met with in putting in the vertical ties has been to find some means of fasten-

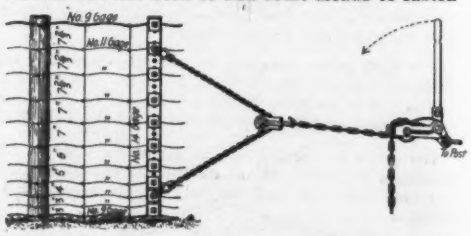


Fig. 4 Page Woven Wire Railway Fence, Showing Stretcher for its Erection.
Page Woven Wire Fence Co., Adrian, Mich.

ing the intersecting wires quickly and cheaply. Fig. 5 shows the Williams fastening, which is now being used on several railways. This fastening comes in the form of a staple, or U-shape, and is fastened, as shown, by one stroke of a specially-constructed wrench. No more time is taken in the process than would be taken in driving the staple into a wooden post. Two men are required for the work, one to operate the wrench and the other to place the staples in position. It is, of course, evident that an entirely new fence can be built if desired. The material for a new

fence will cost about 28 cts. per rod, exclusive of posts, at the factory. This tie is made by E. L. & J. S. Williams, Jerseyville, Ill.

Fig. 6 shows the Eureka metal gate, which has been extensively used on the Atchison, Topeka & Sante Fe R. R. The main feature of this gate is the S-shaped frame of 1½-in. wrought iron pipe, which is given rigidity by the stiff braces across the loops of the S. The wire meshing used may

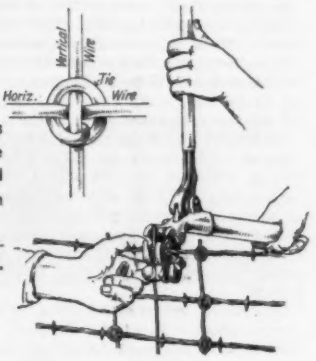


Fig. 5. Williams Tie for Wire Fences and Special Wrench for Applying It.
E. L. & J. S. Williams, Jerseyville, Ill.

be any style corresponding to the adjoining fencing. This gate weighs 50 lbs. with hinges and all other features complete. It is made by the Eureka Gate Co., of Waterloo, Ia.

Fig. 7 shows a device designed for a somewhat similar purpose as the Williams tie—i. e., the strengthening of old horizontal strand fences. It is called by the manufacturers a "stay guard," and has been used on the Boston & Albany, Missouri Pacific and other railways. The illustration shows the construction of the guard and the nature of its

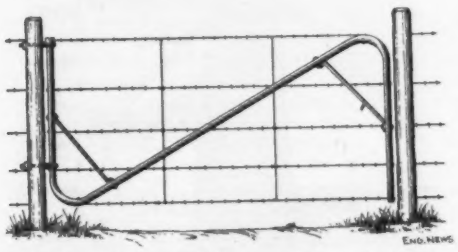


Fig. 6. Eureka Metal Gate for Railway Fences.
Eureka Gate Co., Waterloo, Ia.

attachment to the horizontal strands. A specially-designed wrench makes the attaching of the guard a simple matter. The guard is handled by J. J. Barkley, Old Colony Building, Chicago.

Fig. 8 shows a combination wire stretcher and fastener, also handled by Mr. Barkley, which is designed for use on wooden posts. The manner of stretching and fastening is clearly shown. In a recent proposition to the Pennsylvania R. R. Co. the manufacturer agrees to furnish the necessary guards and fasteners for a seven-wire fence for

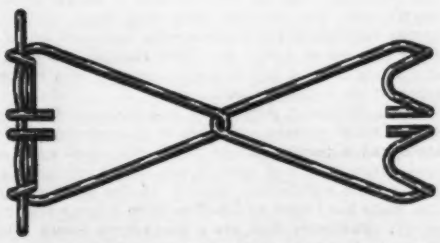


Fig. 7. Galvanized Steel Wire Stay-Guard for Horizontal Strand Wire Fences.
J. J. Barkley, Chicago, Ill.

15 cts. per rod, or to furnish all material, guards, fasteners, wire and steel posts for a seven-wire fence for from 65 cts. to 75 cts. per rod. The fasteners weigh about 1 lb. each.

The fences described above by no means cover all those manufactured, but they are among the most recent, and have all been used to a greater or less extent by railway companies.

PRECAUTIONS IN THE CONSTRUCTION OF LARGE MASONRY RESERVOIRS.*

By M. Dutoit.

No matter how much care is taken in the construction of large masonry reservoirs to keep them from atmospheric influences, by building them in excavation, or by covering them with vaulted roofs, earth and sod, it is impossible, even when they are supplied with water having the same temperature as the surrounding earth, to prevent variations of temperature, and, therefore, cracks in the bottom, as well as the external walls. It is easy to believe that a mass of masonry constructed at a certain temperature will contract or expand as the material becomes cooler or warmer, and that the changes will be considerable at times. As masonry has very little elasticity, it cannot change its form without breaking; and if the mass is of considerable length, the first severe frosts will be followed by cracks, generally toward the middle of the mass. These occur in the exterior walls of reservoirs, and extend across the bottom. Very often still others extend lengthwise along the base of the exterior walls, which thus have a tendency to separate from the bottom. These cracks open more and more as the cold increases, and close together as the temperature rises. It is useless to attempt to stop such cracks which have once opened. During the first change of seasons they will reappear in the same place, or in the immediate vicinity. The best course to pursue is to simply take such special measures as will prevent annoyances in the storage of water or the preservation of the works.

Later on the method will be described which has been adopted with success in Paris for several years to keep the service reservoirs tight in spite of the existence of these cracks. It is there regarded merely as one of the regular works of maintenance. But it is proposed to show first the special methods employed in the construction of the latest reservoirs to protect the foundations against the possible consequences of leakage. These methods are little known, and are perfectly successful.

The bottom and outside walls of the Parisian reser-

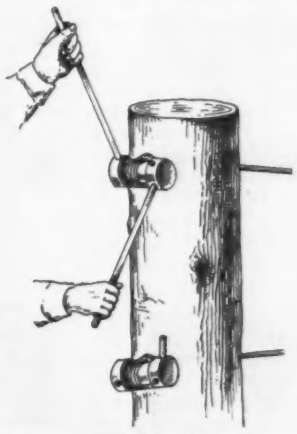


Fig. 8. Combination Stretcher and Fastener for Wire Fences.
J. J. Barkley Chicago, Ill.

voirs are built entirely of a silicious gritstone called meuliere, cement mortar being used, and form, in consequence, homogeneous masses, which might be called monoliths. It would be sufficient to place them on a solid foundation, and give them the readily-calculated dimensions necessary for stability, were it not necessary to take into account the infiltration or permeation of water. This permeation is inevitable, and no matter what precautions are taken to prevent or retard it, the most vigilant maintenance will always be unsuccessful in some respect. It may be said that there is no large masonry reservoir absolutely tight. Cracks are evils which must exist. The best that can be done, so far as is known, is to take special precautionary measures in advance. It is particularly useful to do this when the earth foundation is of such a nature that the presence of water can produce a serious change in its characteristics, either by altering it into a mud, which will slip or run under the weight above it, or by developing hollows, which will lead to settlement, of which the effects may be very dangerous. The first of these dangers occurred at Montmartre, where it was decided to place a reservoir with three superposed basins on the absolutely permeable Fontainebleau sand, and a little above a layer of green marl, which had good supporting power while dry, but was changed by a small amount of moisture into a muddy, sliding mass. The second danger was encountered at Villejuif, where, to obtain the necessary elevation, the reservoir had to be placed on ledges of gypsum, the solubility of which threatened to produce the gradual destruction of the work, if water came in contract with the sulphate of lime.

The engineers in the municipal service have found a safeguard against these dangers in the construction at Montmartre, as well as Villejuif, of accessible galleries between the earth foundations and the floor proper of the reservoir, forming what has been called a double bottom, and affording good drainage. At Montmartre this precaution even has not been considered sufficient, and a second drainage system has been constructed below the galleries of the double bottom in the bed of masonry which carries them. The double bottom has the further advantage of permitting a constant watch to be kept on the condition of the floor proper, on which rests the basin of water. It also affords ample room for the various supply and delivery pipes, and for the tools and apparatus required about the plant. These plans, as adopted at the Villejuif reservoir, built in 1881-82, and the Montmartre reservoir, built in 1888-89, will now be described, together with other details of these two important works.

The reservoir of Villejuif is built entirely in excavation, and is founded on gypsum and upper marl strata. It will comprise four basins with a total capacity of 13,200,000 gallons, but only half of the undertaking, or two basins, have been completed. These are arranged so that they may be operated together, or either one may be emptied, for inspection or cleaning. Each basin is 236 ft. long, 131 ft. wide, and will store water to a depth of 16.4 ft. The bottom has an inclination of 0.2%. The walls have been calculated to resist the pressure of the water, without taking into account the counter-pressure of the earth backing. It was necessary to give the exterior walls a vertical inside face, in order to accommodate the buttress piers supporting the roof, so the outside face is stepped off 14 ins. at two places. The thickness of the walls at the top is 4.6 ft. and at the base 6.9 ft., where they are connected with the floor by a curve of 6.56 ft. radius. The partition wall between the two basins and one of the temporary external walls (which will become a partition wall when the reservoir is completed) have a uniform thickness of 5¾ ft., and are joined with the floor by a curve, like the exterior walls.

The gypsum and split, or cracked, marl being liable to solution and removal by water, it was believed necessary to adopt the system of double bottoms, which provides a means of intercepting the infiltering water, and leading it to the city drainage system, and of securing a uniform distribution of pressure over the entire foundation.

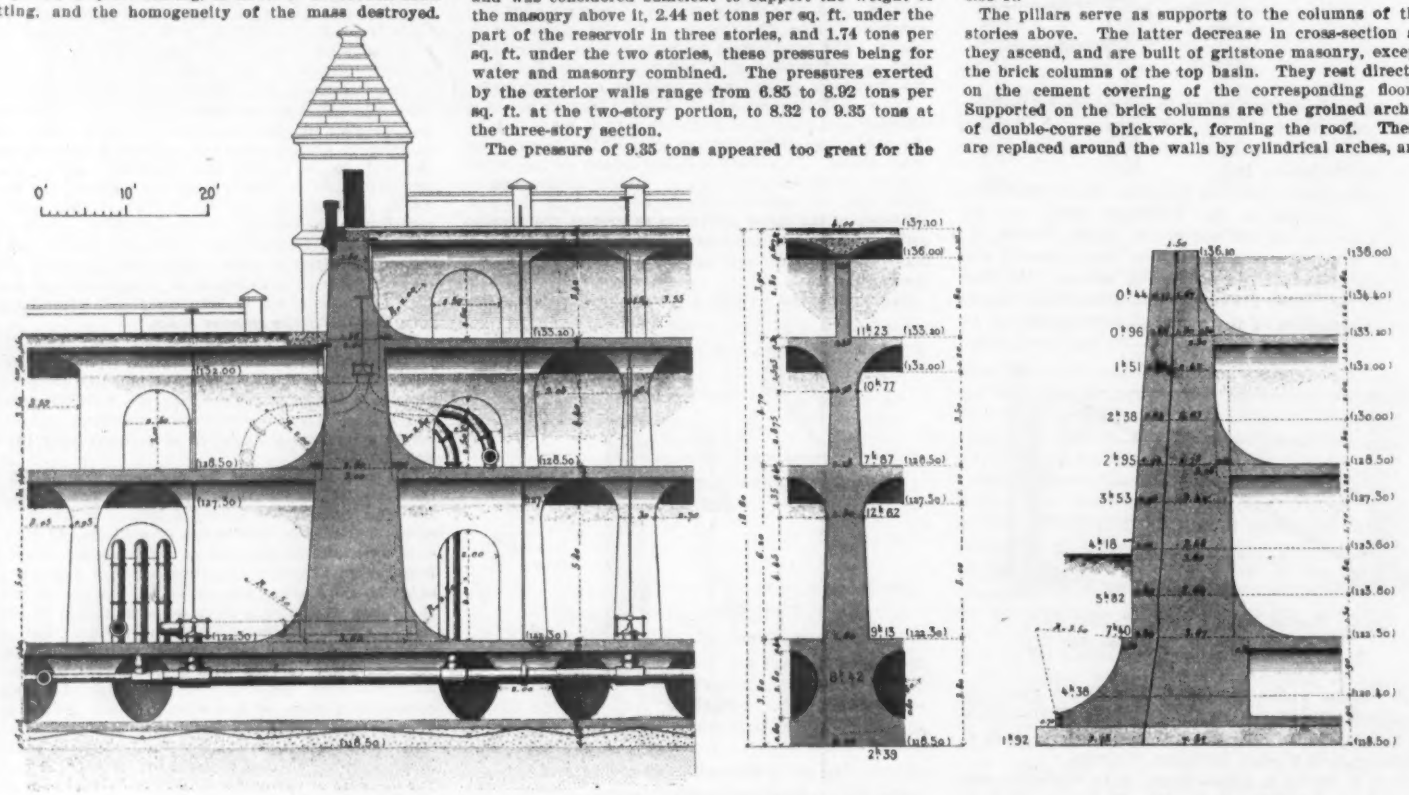
The total thickness of the double bottom is 7.5 ft., the upper and lower floors being each 1.3 ft. thick, and the intervening space having a height of 4.9 ft. The space is formed by two series of galleries, 13 ft. c. to c. of axes, and intersecting at right angles. Each gallery has an elliptical cross-section, with a major axis of 9.2 ft. and a minor axis of 4.9 ft. The pillars left by the series of galleries have as a minimum cross-section a square measuring 3.9 ft. on a side. The upper floor and the curved surfaces uniting it with the walls are completely covered with a 1.2-in. coat of Portland cement mortar, mixed in the proportion of 1 part of cement to 2 parts of fine sand. This is joined to an 0.8-in. coat of Vassy cement, on the exterior and partition walls. The brick columns supporting the roof rest directly on the coating of the floor. The lower part of the galleries of the double bottom have also been given a 1.2-in. coat up to the springing line of the arches. The intrados of these arches has been left uncoated, to allow the water permeating the masonry to fall to the covered lower part of the galleries, which form practically a series of large drains, leading to a sewer. Before turning the arches, which form at the same time the top of the galleries and the upper floor, the columns of the double bottom were finished off to a diamond point, and given a 1.2-in. coating at the elevation of the springing line. The result of this is that any water which may pass through the upper part of the column will be stopped by the impervious layer of cement.

Owing to this arrangement of parts, the cracks in the true or upper floor occur necessarily at the crown of the arches, where there is the least thickness. The water passing through these cracks falls to the galleries and is led to the public sewers. On the outer face of the exterior wall, at the level of the upper floor, a slightly undulating cement-lined gutter was formed. At each low point of the gutter a drain leads through the wall to the gallery. Above the outer mouth of the drain there is a filling of stone. In case cracks occur in the exterior wall, the water in the reservoir will escape into the stone filling, from which it will pass to the gutters, and thence through the drains in the walls to the galleries. The accessibility of the galleries enables all parts of the reservoir to be thus kept under constant surveillance.

The reservoir proper, comprising the double bottom, the exterior walls and the partitions, was built of gritstone and Portland cement mortar, the latter being mixed in the proportion of 673 lbs. of cement and 1 cu. yd. of sand for the lower half of the double bottom, 589 lbs. of cement for the upper half, and 505 lbs. for the walls.

* Translated from the "Annales des Ponts et Chaussees," June, 1895.

The reservoir at Villejuif, like most of those about Paris, is covered by brick arches supported by brick columns 18 ins. square, by pierced buttresses of 19.7 ft. length and 18 ins. thickness, and by brick buttress piers at the angles. All are independent of the exterior walls, which thus do not have to take the thrust of the roof. The roofing bricks have the same length and width as ordinary French bricks, but their thickness is only 1 in. They are laid flat on the centers, and the joints are made with a mortar mixed in the proportion of 757 lbs. of Portland cement to 1 cu. yd. of fine sand. The bricks used at the angles are specially formed with one corner bent out of the plane of the main body. The construction of the arches required particular care. They have a span of 11.6 ft., a rise of 1.97 ft., and a thickness of 2.8 ins. The cloistered arches at the angles are first formed, then the cylindrical arches around the exterior walls, and finally the groined arches over the body of the basin. The special bricks are first laid in position on the centers, and then the remainder are laid, beginning at the springing and working toward the crown. The arch has two courses of brick, which are carried along at the same time. Slow-setting cement is preferred in the roofwork. The men are obliged to move about over the work, and as the centers are not always absolutely rigid, the mortar in the joints, if quick setting, is liable to be broken after setting, and the homogeneity of the mass destroyed.



Longitudinal Section. Section thro' Pier. Section of South Wall.

MASONRY RESERVOIR OF MONTMARTRE, PARIS;
Built in 1888-89.

Centers are struck three or four days after the work is finished.

The haunches of the arches are filled with 1 ft. of lean concrete, formed in the proportion of 294 lbs. of Portland cement to 1 cu. yd. of coarse sand or gravel. Then an 0.8-in. coating of Portland cement mortar is spread over the whole roof. Drain pipes are carried through the arches from each low point on the outside of the roof. The rain water which passes through them joins the storage water in the reservoir, without injuring the quality of the latter, as it is unfiltered river water. Above the mouths of the drain pipes there is a 12-in. bed of small stones, and over the whole roof there is a 16-in. layer of earth, to protect the masonry from the weather, and to keep down the temperature of the stored water.

The Montmartre reservoir is located on the top of the "Butte," at the side of the Church of the Sacred Heart, and covers an area of 24,800 sq. ft. Its capacity is 2,000,000 gallons. It consists of five totally independent basins, each provided with its own system of pipes and valves, so that it may be emptied for inspection or repairs. The basins are in two groups, separated only by a partition wall, and supported by a double-bottom foundation. The first group, located at the side adjoining the church, comprises three superposed basins. The lowest has a depth of 16.4 ft. available for storage, the second has a depth of 11.5 ft., and the topmost has a depth of 9.2 ft., or a total available depth of 37.1 ft. The second group comprises two superposed basins; the lower has a storage depth of 16.4 ft., and the upper has a depth of 11.5 ft., corresponding to the middle basin of the first group.

The general foundation of the work was a concrete bottom 30 ins. thick, resting on a bed of fine yellow sand, about 16.4 ft. thick, overlying the marls above the gypsum. The leveling of the earth at the elevation selected was made necessary by the very old excavations and other works which were at that level and had to be entirely effaced to obtain a uniform foundation for the reservoir. When the preliminary studies were in progress, borings were made at different places on the proposed site to find out the nature of the strata below. One of these borings revealed an old filled-up well, of which the existence had been forgotten. The attention of the municipal mining department was called to this discovery, and the well was opened to a certain depth. The interior diameter was found to be 8.2 ft., and the lining of pure gypsum. A boring 131 ft. in depth down the middle of the well showed that the shaft passed the upper beds of gypsum. An examination was then made to discover if this shaft had been used to develop the plaster gypsum beds of the region, but a series of borings showed that this was not the case, and that the rock had not been disturbed. The bed of sand over the marl is about 16.4 ft. thick, and was considered sufficient to support the weight of the masonry above it, 2.44 net tons per sq. ft. under the part of the reservoir in three stories, and 1.74 tons per sq. ft. under the two stories, these pressures being for water and masonry combined. The pressures exerted by the exterior walls range from 6.85 to 8.92 tons per sq. ft. at the two-story portion, to 8.32 to 9.35 tons at the three-story section.

The pressure of 9.35 tons appeared too great for the portion of the wall facing the city, and very near the ancient quarries of plaster rock, which had been broken in and filled. The proximity of these openings of considerable size and great depth, filled more or less imperfectly, necessitated as a primary precaution the construction of a guard wall to prevent the sand from sliding into the openings of the quarries under the loads to come upon it. The wall is of concrete, 6.5 ft. thick, and nearly 10 ft. below the general level of the foundation, and extends only along the face, near the old excavations. It was built before the bottom of the reservoir, and is independent of it.

The bottom of concrete has been built in such a manner that the water permeating the masonry cannot pass entirely through it, and the surrounding earth cannot be injured by leakage from the reservoir. For this purpose the 30 ins. total thickness of the bottom has been divided into two portions. The lower part, having an average thickness of 20 ins., has its upper surface formed into a series of shallow channels, covered with an impervious layer of Portland cement mortar. Four-inch open-joint tile drains are placed in the lowest part of each channel, and lead to an accessible gallery, forming a main collector, which connects with a public sewer. The second portion of the concrete, which is 10 ins. thick, is placed above these drains. Any water which may permeate the upper part of the floor is guided by the impervious coating to the drains, and thus to the sewer, and has no opportunity of reaching the sand foundations.

At the first step of the outside face of the exterior walls a channel has been formed, like that at the Villejuif reservoir, to collect the water from the outer filling of stone around the walls, and carry it to the pipes passing through the latter into the reservoir.

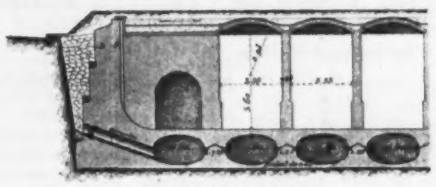
The height of the waste pipes being fixed by the necessity of having them discharge into the distribution pipes of the entire Butte Montmartre section, and the elevation of the foundations being determined by the conditions previously mentioned, the galleries were given the exceptional height of 7.9 ft. These galleries are of egg-shape cross-section, 7.9 ft. high, and 6.5 ft. wide at the springing line. They intersect at right angles, forming a series of groined arches in the center, and cylindrical arches around the walls. The thickness of the crown is 16 ins., and that of the invert is 10 ins. on an average, making the total height from the bottom of the concrete foundation to the lowest basin 12.5 ft. The inverts of all the galleries have a general inclination of 0.2% toward the main collector leading to the sewer. They are covered with a 1.2-in. layer of cement to a height of 1.6 ft. only. All the remaining portions of the interior of the galleries are uncoated, so that all water which may permeate them can escape to the lower floor. The galleries are 13.1 ft. apart, c. to c. of axes, thus making the least thickness of the pillars 6.55 ft.

The pillars serve as supports to the columns of the stories above. The latter decrease in cross-section as they ascend, and are built of gritstone masonry, except the brick columns of the top basin. They rest directly on the cement covering of the corresponding floors. Supported on the brick columns are the groined arches of double-course brickwork, forming the roof. These are replaced around the walls by cylindrical arches, and at the angles by cloistered arches resting on buttress piers of the same thickness as the columns, and pierced with passages from 6.5 to 8.2 ft. wide. The columns and buttress walls are covered with a coat of cement mortar, like the exterior walls and floor, while the arches supporting the floors remain uncoated, so as to allow any water which may pass through the coating of a basin to pass into a lower basin, or into the galleries of the double bottom.

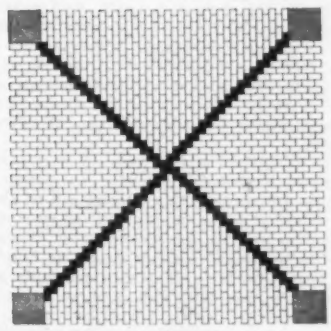
As an additional precaution, and because the height of the walls exposes a portion of their surface to the south and a portion to the north, thus producing unequal expansion and contraction, strips of iron have been placed within the masonry of the exterior wall. The walls have been designed to have a large factor of safety. The outer face has a pronounced batter, while the inner face has a series of steps, reducing the thickness of the masonry from 15.6 ft. at the base in the large basin and 13.4 ft. in the smaller one to 4.9 ft. at the top. Curves of 6.5 ft. radius connect the walls and floors of the various stories. On account of the architectural form of the reservoir, which has in plan a curve of 52.4 ft. radius on the south side, where the earth has the least supporting power, the base was extended 8.2 ft. beyond the usual line, and the exterior part of the wall curved out so as to obtain an additional bearing surface, and thus diminish the intensity of the pressure. The strips of iron measure 3.2 × 0.8 ins., and come in lengths of 16.4 ft., and are firmly connected together. At the angles of the walls, the

strips are formed into eyes through which pass 2-in. anchorage bars from 3.3 to 6.5 ft. long. The strips are placed at abont the elevation of the waste pipes, where the pressure is a maximum. They are about a third of the thickness of the wall from the interior face, so that the exterior temperature, the variations in which exceed considerably those of the stored water, may have as little influence as possible on the metal.

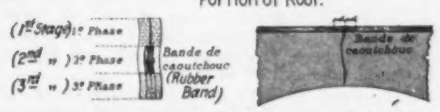
The two ties of the small basin were placed readily in the exterior walls, which form a trapexium. A particular arrangement had to be adopted for certain anchorages, which could not be placed in the usual manner at the angles where openings were left for stairways. Here it was necessary to construct a special anchorage about the openings, composed of four strips, with anchors at the ends and connected with the ties in the walls.



Section of Outer Wall and Portion of Reservoir.



Plan.
Portion of Roof.



Method of Repairing Fissures with Rubber.

Masonry Reservoir at Villejuif, France.
Built in 1881-2.

The binding of the large basin presented a difficulty in the curvature of the south wall. The regular ties were available only by allowing one of them to pass through the reservoir along the chord of the arc, thus failing to stay the curved wall. Another solution was preferred, consisting in tieing the curved wall to the buttress piers of the cylindrical arches in each basin by a special tie in each supporting wall. It is placed at the elevation of the waste pipe, and consists of an 0.8 × 3.2-in. strip of iron, carrying a vertical anchor bar at the inner end, and a horizontal bar in the exterior walls.

The materials used in the construction of the reservoir were the following: The concrete of the foundations is composed of 3 parts of gravel and 2 parts of Portland cement mortar mixed in the proportion of 757 lbs. of cement to 1 cu. yd. of sand. The exterior walls up to the level of the top of the floor of the lower story are built of gritstone, laid in a mortar mixed in the proportion of 780 lbs. of cement to 1 cu. yd. of sand. From this level to that of the bottom of the upper story, the proportion of cement is reduced to 772 lbs., and above that to 589 lbs. The brick masonry has been laid in a mortar having 780 lbs. of Portland cement to 1 cu. yd. of sand. The filling for the haunches of the vaulting is a concrete of 294 lbs. of Portland cement to the cubic yard of coarse sand. It is covered with an impervious coping, which drains off the rainwater to the outside of the reservoir, as the upper basins at Montmartre, unlike the Villejuif basins, contain water which must be kept uncontaminated. The coating of the floors and curves is 1.2 ins. thick, and is formed of a mixture of 1,177 lbs. of Portland cement to 1 cu. yd. of sand. Vassy cement has been employed only for the coatings of the vertical walls. These coats are 0.8 in. thick, and are made with equal parts of cement and sand.

The results obtained from this system of construction have justified the methods followed. During the 11 years that the Villejuif reservoir has been in use, and the six years of service of the Montmartre reservoir, apart from a few cracks due to expansion in the floors, there has been no movement of any part of the works and no trace of settlement has been detected. This is particularly noteworthy at Montmartre, where the exceptional height of the walls, the unfavorable position of the work and the nature of the earth offered serious difficulties.

Cracks due to expansion or contraction occur more often in the bottoms than in the exterior walls. When a crack has been located, the coating of cement mortar is picked away for 2 to 2½ ins. on each side of it, the fissure is scraped with an iron blade, and is then washed well. A slip of wood or cardboard 0.04 to 0.08 in. thick is placed in the crack, and a coating of Vassy cement 0.4 in. thick is laid on each side of it. When the slip is withdrawn, it leaves an opening of uniform width. The cement is thoroughly dried by means of small charcoal braziers, and the empty space is then filled with pieces of pure, unvulcanized india-rubber, cemented to the coating by a solution of india-rubber in benzine. Finally, the opening is closed with cement mortar and surfaced off. This last coat generally cracks, but the water that penetrates it is stopped by the india-rubber, which also permits a slight expansion or contraction of the masonry. This method of repairing cracks is due to Chief Engineer Couche, who has introduced it quite generally in the Parisian waterworks service.

NOTES FROM CITY ENGINEERS' AND OTHER MUNICIPAL REPORTS.

Boston, Mass.—Estimates for municipal docks at East Boston are included in the last report of Mr. Wm. Jackson, M. Am. Soc. C. E., City Engineer of Boston. Assuming no rock to be encountered in construction, and no extraordinary difficulties with foundations, Mr. Jackson estimates that each 10,000,000 sq. ft. of dock area would cost $7,500,000. This does not include the cost of paved roadways, tracks and buildings, and is on the basis of 40 cts. per cu. yd. for filling and $70 per lin. ft. of sea wall.

The last report of the Superintendent of Streets for the city of Boston, Mr. Bertrand T. Wheeler, contains a somewhat detailed description of Commonwealth Ave. This avenue now extends under one name from the Public Garden to Newton, 5.59 miles within the limits of Boston, and then four miles further, but still under the same name, in the city of Newton. The avenue is not completed at all points in either city. Its width in Boston ranges from 120 to 200 ft., and part of it is laid out as a parkway. In general, the avenue has telford roadways. Grass plots and trees are provided a part of the way.

Medford, Mass.—From 20 to 25 cts. a load has been received for a portion of the ashes of the city from private parties for filling purposes, according to the last report of the Street Commissioner, Mr. John P. Prichard. During the year ending Feb. 1, 1895, there were collected 6,794 loads of ashes, at a total cost of $2,572, or about 37 cts. a load. The total credits on this account are given as $285, which would indicate that from 1,100 to 1,400 loads were sold. The collectors have orders to remove no ashes with which garbage has been mixed. The ashes are removed once a week

Troy, N.Y.—During the two years ending Feb. 28, 1895, covered by the report of Mr. M. R. Sherrerd, Assoc. M. Am. Soc. C. E., then City Engineer of Troy, numerous improved methods of street paving were introduced. Among these may be mentioned the following: The setting of all curbstones in concrete; the adoption of standard forms of street intersections and crosswalks for brick and granite pavements, the principal feature of which is having all joints extend towards the two center lines of the intersection, in order to prevent longitudinal wear by wheels; the introduction of brick pavements; the substitution of cement grouting for paving-tar in filling joints in brick and granite pavements. Mr. Sherrerd is now Engineer of the Street and Water Board of Newark, N. J.

Passaic, N. J.—Appended to the city reports for 1894 are some reproductions of detail drawings of drains under street railways at street intersections, and their connections with the sewers. Messrs. Wise & Watson were the engineers for this work. There are also appended to this report some tables of average dimensions of vitrified sewer pipes used at Passaic, accompanied with drawings lettered to correspond with the dimensions given in the tables for pipe of different sizes.

Philadelphia, Pa.—During the year 1894 the passenger street railways of Philadelphia repaved 131 miles of streets, mostly, if not wholly, in connection with the change from horse to trolley service. Of this repaving, 93 miles was Belgian block; 37 miles was sheet asphaltum, on a bituminous base; and about two miles vitrified brick, on a concrete base. The pavements of all these streets must be maintained by the trolley companies.

Wilmington, Del.—The cost of 23,995 sq. yds. of brick pavement, laid on 11 different streets, is given in detail for each street in the report of the Street and Sewer Department for the year ending Jan. 31, 1895. The brick used are given in the report as fireclay shale, Hallwood shale, and silica, with one street covered with Metropolitan shale block. Nearly all of the brick was laid on a stone foundation, most of which was old rubble-stone pavement taken up and used over. The cost of the 23,995 sq. yds. of pavement was $42,677, or about $1.80 per sq. yd. This cost per square yard was divided approximately as follows: Grading, 16.67 cts.; stone foundations, 23.43 cts.; brick delivered, 100.81 cts.; laying brick, 10.02 cts.; sand, 10.33 cts.; grouting, 4.55 cts.; rolling foundation, 0.28 cts.; inspection, 1.5 cts.; miscellaneous, 12.06 cts.

Peoria, Ill.—The last report of the Department of Public Works contains numerous valuable tables giving the extent and cost of various kinds of pavements within the city, tests of brick submitted in competition or otherwise, and of brick from old pavements, and also tests of cements. Mr. Jacob Harman was City Engineer during the year covered by this report. The brick pavements constructed in 1894 were nearly all from bricks 2¼ × 4 × 8 ins., laid on a stone foundation. The total length of streets covered with brick during the year was 3.38 miles, ranging in width from 26 to 60 ft., and aggregating 76,887 sq. yds. The total cost of the work was $131,891, or an average of $1.71 per sq. yd.

Duluth, Minn.—A good feature of the reports of the Board of Public Works is the use of an extra printed title to the large sheets of folding tables, of which many are given in the report for each year. This title is printed on the blank side of the sheet, on the uppermost face of the fold as the report is opened It renders unnecessary the opening out of a large sheet to ascertain its contents. The practice might often be followed to great advantage on folding sheets of tables, maps or illustrations, at least where the number of these in a book is large.

Minneapolis, Minn.—Among the many tables relating to the work of the City Engneer during 1894, Mr. F. W. Cappelen, are a number giving the results of brick and cement tests. One of these presents the results of cement inspections during the years 1885 to 1894, inclusive, giving the number of barrels accepted and rejected each year, and for the period, with the percentage rejected, and the avrage tensile strength per square inch of 24-hour briquettes. Five brands are included in the table. The highest percentage of rejections is 60%, or 900 out of 2,400 bbls. of one brand in the year 1892. There were some rejections for each brand inspected in most years, but the rejections were nearly always below 3% of the total inspections.

Another table gives the average results for the seven years 1888 to 1894, inclusive, of tensile tests of neat cement, of 1 cement and 1 sand, and 1 cement and 2 sand, these figures being for briquettes ranging from 24 hours to five years in age. Crushing strengths are also given for briquettes of from one month to one year in age. The figures are too extended for quotation here. Those interested can doubtless obtain copies of the report by applying to Mr. Cappelen.

Omaha, Neb.—Mr. Andrew Rosewater, M. Am. Soc. C. E., City Engineer of Omaha, states in his report for 1893 that after much study over Kutter's formula, in connection with sewer discharges, he made the discovery that

> after computations of velocities and discharge are made for all sizes of sewers upon a grade of 1%, the same sewers, upon any other grade, will discharge with velocities and in quantities proportionate to the square root of the grade.

Mr. Rosewater gives in his report a table based upon the above, which he says will save "90% of

labor in sewer computations." The table contains on one side the computed velocities and discharges for sewers from 4 ins. to 20 ft. in diameter, on a 1% grade, and on the other side grades per hundred, ranging from 0.04 to 20, with their respective square roots. To use the table, the velocity or discharge for a given sized sewer, on a 1% grade, is found in the left part of the table, and then multiplied by the square root of the actual grade, as given in the right-hand side.

The report of Mr. Rosewater for 1894, and of the Board of Public Works for the same year, present in detail a controversy which occurred in Omaha over the use of other than material from Trinidad Lake for asphalt pavings. The City Engineer, Mayor and City Council were finally successful, and succeeded in awarding a contract at $2.07 per sq. yd., the contractor having the option of using California or Bermudez asphalt, or asphalt from the Island of Trinidad. This price was about 20% lower than that at which the lake product was offered. Mr. Rosewater vigorously argues his side of the case in favor of competition, and the Board of Public Works makes extensive quotations to show that he is wrong in many of his points. Those interested in the subject should not fail to secure these two reports.

In addition to the discussion of asphalt paving, Mr. Rosewater considers at some length the development of paving in Omaha, and the serviceableness and cost of the different kinds employed. Extensive tables are presented, showing the results of observations during the year on the different kinds of pavements in use.

A large table and diagram is appended to Mr. Rosewater's report, giving the standard crowns for streets of different widths and grades, one section of the tables being for brick, stone and wooden pavements up to 20% grades, and the other for asphalt, up to 7% grades, the figures being given for each change of 1%, and for widths of from 20 to 80 ft., at 5-ft. intervals. The table is computed from the formulas

$$C = \frac{w}{1{,}600}(20 - i) \text{ and } C = \frac{w}{600}(9 - i),$$

the first formula being for brick, stone and wood, and the last for asphalt pavements, where C = crown of pavement in feet, w = distance between curbs in feet and i = number of feet-fall per 100 ft. of street. Where the crown is less than 0.5 ft., the gutter is made 0.5 ft. wide, and where it is more than 0.7 ft. it is made 0.7 ft. For intermediate crowns the gutter width is made equal to the crown.

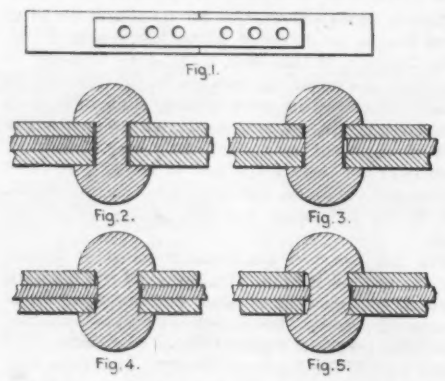
Toronto, Ont.—A systematic examination and analysis of asphalts and asphalt cements used for paving purposes has been carried on here since 1892, with a view of determining the relation between the composition of these materials and the results obtained by use. Mr. E. H. Keating is city engineer, and Mr. H. D. Ellis is engineer in charge of roadways. The sub-report of the latter in Mr. Keating's report of 1894 discusses pavements and paving materials at considerable length.

In order to compare the results of tests of paving brick at Toronto with those made elsewhere, standards were compiled from tests made in the United States, and are given in the report of Mr. Ellis. Most authorities, Mr. Ellis states, consider the abrasion test the most important. At least six bricks should be taken, and good brick should not lose more than 9% by weight in 2,000 revs. of the tumbler, nor more than 12½% for 4,000 revs. The loss in cubic inches per square inch of surface should not be over 0.09. For absorption not more than 2¼% should be allowed after three days' immersion. Crushing tests are dismissed with the remark that, as a general rule, any brick which withstands the abrasion test will be all right in this particular. Regarding transverse strength, Mr. Ellis states that a few brick which show a small resistance to abrasion may show high transverse strength, and this test is omitted on the principle that "unless a brick will stand the abrasion test, it is no good examining it for the other three qualities." Mr. Ellis afterwards states that he has contented himself "with limiting the tests to abrasion and absorption, as the crushing and transverse tests require machinery only obtainable at the School of Practical Science, in Toronto." It appears from the latter part of this quotation, that the absence of facilities for making all the tests is an important factor in omitting some of them.

SOME FRENCH TESTS OF RIVETED JOINTS.

Some interesting experiments in regard to the strength of riveted joints have recently been made in France by the committee of engineers commissioned by the Minister of Public Works to investigate this and other questions relating to the stability of metallic structures We abstract the general conclusions which these experiments seem to justify, from a very complete article in the "Annales des Ponts et Chaussees" for January, 1895, and refer such of our readers as wish to go into the nature and results of the tests more in detail to the article itself. The tests were all made with narrow joints, and therefore are of limited use in practice, but some figures are given of the friction between both hand and machine-riveted plates, which will repay study

The experiments indicate that the contraction of the hot rivet in cooling strains the metal beyond the elastic limit, and that this strain is more pronounced near the circumference than at the center of the rivet. The rivets when cooled do not completely fill the rivet holes, but exert a pressure on the plates so that they offer a great resistance to



Sections of Riveted Joints Tested Under the Direction of the French Minister of Public Works.

sliding on one another. This resistance to sliding, or the friction, increases as the elastic limit of the rivet metal increases, but its limit is extremely variable, depending upon: the nature and quality of the metal from which the rivets are made; the temperature at which the rivet is driven; the temperature of the rivet at the end of the driving; the style of the riveting, and the manner in which it is done.

The resistance to sliding, or friction, which can be counted upon in actual practice with joints made with three rivets or less is as follows: For rivets driven by hand at a clear red heat, so as not to distort or cramp the plates, and the driving continued until the rivet head had become black:

	Friction per sq. in. of rivet sections, lbs.	Elastic limit* per sq. in., lbs.
Iron rivets	568.9	2,560
" "	668.5	2,986
Steel "	640	2,986
" "	568.9	3,271

For rivets driven at white heat, with a pressure of 8,534 lbs. per sq. in. of rivet section so as not to distort or cramp the plates, and the pressure maintained until the rivet head became black:

	Friction per sq. in. of rivet section, lbs.	Elastic limit* per sq. in., lbs.
Iron rivets	711.1	2,560
" "	824.9	2,986
Steel "	853.3	2,986
" "	938.7	3,271

* The limits of elasticity were obtained from bars previously heated to a dull red. An elongation of 12% and 18% was required for iron and steel, respectively.

When a butt joint is made, as shown in Fig. 1, with drilled holes, the position of the rivet appears to be as shown by Fig. 2. When the joint is subjected to a tensile stress, at first the position of the rivet in the hole is not changed and the holding power of the joint is simply the friction of the plates upon each other and upon the inside of the rivet head. The tension, however, tends to decrease the thickness of the plate, and consequently the gripping stress of the rivets; and finally the center plate slides so that the position of the rivet in the hole appears to be as shown in Fig. 3. As the pull continues the rivet bends and the rivet heads slide on the plates until the rivet assumes the position shown in Fig. 4. If the stress is continued the rivet begins to be cut into by the plates; the bending increases, and the holes become distorted as shown by Fig. 5. At last the metal in the plates begins to flow, and rupture takes place at the joint. When there are several rivets on each side of the joint, all the rivets on the same side yield at the same time. Often the rivet shears on two planes at the

WATER POWER OF CARATUNK FALLS, KENNEBEC RIVER, MAINE.*

By Samuel McElroy, M. Am. Soc. M. E.

Catchment Basin.—The basin of the Kennebec is compact in form, bold in contours, abounds in lakes and forests, has a heavy and quite regular rainfall, a cold climate favorable to its stream flow, and is capable of large development in power. The length of the river, from its head waters of the "Moose" to "Moosehead Lake," is 72 miles; to Caratunk Falls, 137 miles; to Augusta, 184 miles; to the ocean, 227 miles. Its divides in the White Mountains rise to 3,113 ft. above tide; Moosehead Lake being 1,023 ft., Caratunk Falls 316 ft., Skowhegan 220 ft., Kendall's mills 76 ft., Augusta dam 17 ft. above tide.

The river basin is about 5,917 sq. miles. About 3,800 sq. miles are in forest.

There are 311 lakes and ponds, with a joint area of 450 sq. miles. While there is a large snowfall, the under stratum thaw maintains winter stream flow, and spring freshets are delayed until the ice, as a rule, is brittle, and does not make the dangerous freshets of milder climates. Upper pond ice sheets strongly tend to prevent sludge ice, and maintain full power head on the dams.

Power Conditions at Caratunk.—A very narrow gorge compresses the whole flow of a comparatively broad river into a cascade with a natural fall of about 28 ft., while immediately below, the river at once widens into still broader expanse for several miles. There are here, then, a large natural pondage above the falls; a site already formed for race, wheel pits, and mills; a powerful fall, on this immediate site, and an estuary directly obviating obstructions from flood backwater.

Caratunk drains four great tributaries: The Moose River, Dead River, Moosehead Lake and Kennebec River, with a total drainage area of 2,850 sq. miles. The tributaries to the Augusta dam, below Caratunk, are the Carrabasset, Wesserunsett, Sandy and Sebasticook, with a total of 2,287 sq. miles.

Rainfall.—From statistics collected at the lower end of the river, the mean fall for 50 years (1839 to 1888, inclusive) is 44.494 ins. The maximum fall in 1887, 54.64 ins.; minimum, 1860, 33.71 ins.

Power Investment.—Without time to make a continuous gage of the river, it was necessary to estimate its ordinary merchantable value, at this point, from a study of its hydrology. With 28 ft. available flood fall (wheel heads being usually reduced in freshets from back water), and a mean rain of 44.494 ins., minimum 33.71 ins., on such a basin, a safe, present plant outlay for 5,000 HP. was determined from experience on this and other rivers.

There is sometimes a conservative and proper, and sometimes an "intensely scientific" tendency to disparage stream flow for city supply and power use, because in every season there is a short time of extreme minimum flow, and at intervals a year of much reduced flow. A basin with a rain supply of 45 ins. per year, or a mean of 3.315 cu. ft. per second per day, may, for a few days, run as low as 0.22 cu. ft.; the Kennebec sometimes down to 0.6 cu. ft. for 20 to 25 days; the Merrimac, 0.31 cu. ft.; Delaware, 0.30 cu. ft.; Passaic, 0.22 cu. ft.; Croton, 0.15 cu. ft. So the rainfall—with a mean for 50 years—on the Kennebec may vary from 54.64 ins., 1887, to 33.71 ins., 1890; but the mean of all the great basins shows these as exceptional years, with large flood waste in the wet months; which dictates the common-sense of catchment and storage.

Authorities, like Professor Trowbridge, in "Water-Powers of the United States," p. 8, assert that the "total amount discharged by streams falls as low as 12 (0.885 cu. ft. per second per square mile) or 15 ins. (1.1 cu. ft.) over the entire drainage basin, at intervals of from 5 to 10 years." Nothing can be clearer than the wisdom of adequate provision for exceptional years and weeks, but very great loss of mean available supply and power would follow the reduction of plant to extreme cases.

Kennebec Power.—Applying these conditions, the relative value of the Augusta and Caratunk dams may be examined. Augusta Dam is 956 ft. long, with a fall of 17 ft. It has a log chute on the east end, and a large mill

* Condensed from a paper presented at the New York meeting of the American Society of Mechanical Engineers.

on the west end, of 3,000 HP. The measurements for low water show a mean in 1866, with 45.63 ins. rain, of 2,916.6 cu. ft. per second, or 9.494 cu. ft. per second per square mile for July, August and September.

I learned from an intelligent gate-house keeper, of long experience here, that in the lowest summer run of 20 to 25 days (common on other streams) the depth of the dam is about 6 ins., and the usual depth 1 ft., for the balance of the dry season, of about 80 to 90 days in all, before and after this reduction; and it was reported as exceedingly rare to have no flow on the dam.

With 3,000 HP. in use, 6 ins. flow equals 0.19 cu. ft. per second per sq. mile, and the mill use, at 70% duty, is 0.4056 cu. ft., or a total of 0.5956 cu. ft. per second. The usual use at Lawrence, very near stream low run, is 0.5271 cu. ft. per second per sq. mile per day. A very low run, Aug. 21-26, 1876, gave 0.5 cu. ft.

The extreme low run assumed by state authorities (W. P. Maine, p. 92) is 1,300 cu. ft. per second, or 0.22 cu. ft. per second per sq. mile. Applying this to the extreme year of 1800, the equation stands:

25 days at 0.22 cu. ft.		5.50
60 " " 0.456 "		27.36
280 " (50% flow) at 1.2415 cu. ft.		347.62
365		380.48

Per day, 1.042 cu. ft. per second per sq. mile.

At 1 ft. flow (neglecting the waste at the log chute), the dam gives 0.538 cu. ft., and with the mill, 0.943 cu. ft. per second per sq. mile.

Caratunk Power.—In applying these observations to this fall, it is evident that its power conditions are much more favorable than Augusta, below it, or than the Merrimac, at Lawrence.

To analyze the supply as to its capacity and as to its moderate mercantile value, basing one on the mean annual rain of 50 years, 1839 to 1888, and the other on the lowest record year, 1860, tables have been compiled, which show that the mean rainfall for the period of 50 years was 3.277 cu. ft. per second per sq. mile; for the minimum year 1800 it was 2.487 cu. ft. per second per sq. mile.

In the tables the relative monthly flow is assumed, on percentages derived by other stream analyses, as proximate guides to an estimate of the deficit to be supplied to maintain a given power. A flow of 50% of the mean annual rainfall (1.638 cu. ft. per second per sq. mile), maintained, would give wheels of 70% duty (a moderate estimate for those actually used), for 24 hours' use, for full-day pulp mills, 10,374 HP. The minimum year of 1860, in like manner, 60% flow, or 1.492 cu. ft. per second per sq. mile, would give 9,450 HP.

Present Value.—With equal rainfall, better conserved by climate and location, and with fivefold the proportionate storage reserve of the Merrimac, in a case where it seems to be little needed, from limited wheel use, this fall ought to command much greater supply in dry seasons.

It was evident then, not only that this fall had a great prospective value which will place it in the front rank of great powers, but a present value, easily and cheaply developed, of not less than 5,000 HP., as a moderate result for full power operation.

Improvements.—In the fall and winter of 1890-91, a dam was built by the Moosehead Pulp & Paper Co., under the superintendence of D. T. Mills, Hydraulic Engineer, with a large pulp mill on the west side of the falls, intended to develop about 3,500 HP. on that side. Three "new American" wheels of 850 HP. each have been put in, 66 ins. diameter; one "Special," 45-ins., of 390 HP.; a 16-in. "Electric," of 42 HP., and a pair of 13-in. horizontal wheels for a centrifugal pump of 80 HP., in all about 3,000 HP.

Measurements made through 1890, a very dry year, show a minimum flow of 6,000 HP. (on 70% wheels).

Relative Cost; Steam and Water Power.—Estimates for cost of steam substitution are necessary in mill power expert cases, and much difference of opinion is sometimes expressed. Like all other engineering questions, this is to be determined by the principles involved, in which special local cases may differ, without affecting the general rule. In this case the outlay for dam, flume, head-gates, wheel-pit, etc., was about $15 per HP. of 3,500 actually provided on the west side; the cost of wheels, for 3,000 HP., about $9, or $24 in all.

Similar steam plant could not be furnished for less than $65 per HP. for boiler, engines and buildings. A fair estimate of its annual fixed expense is: Depreciation, 4%; repairs, 4%; supervision, 1%; taxes, ½%; insurance, 1½%; interest, 5%; total, 16% on $65, $10.40.

Annual operation for 3,000 HP., 300 full days per year (pulp mill), closely estimated:

Coal, 48 lbs. per HP. per day, 300 days, 14,400 lbs.; 6.42 tons at $6		$38.52
Attendance, engines, per day	$10.00	
Boilers	18.00	
Cleaning	3.00	
Oil and supplies	1.50	
	$32.50	
Three hundred days, $9,750 ÷ 3,000 HP.		3.25
Total per HP.		$41.77

Turbines, etc., fixed charges:

Depreciation, 2%; repairs, 2%; supervision, 1%; taxes, ½%; insurance, ¼%; interest, 5%, or 11% on $24	$2.64
Attendance per HP.	2.00
Race, etc.	.60
Total	$5.24

This shows, in a local case like this, a proximate comparison. Cotton and similar mills, unlike pulp mills, requiring careful heating, have in steam plant the advantage of use of the exhaust steam, and in other ways local conditions will modify the results.

As a practical comment on the cost of steam power, the Central Pacific mill at Lawrence, with 29 mill powers, or 1,740 HP. in ordinary use, and with a 1,000-HP. steam plant, has preferred to pay $12 per day per mill-power for surplus water, for months together, rather than run this expensive plant. This is about $50.40 per HP. per year of 277 days.

The usual Lowell estimate of steam power is $75 per HP. per year, and $3 per week is the common price paid for it in New York and other cities where rented. The Lowell rental of water power at $1,200 per mill-power per year is for 277 days, $4.32 per day, or a mean of $20 per HP. (shaft) per year.

Niagara Water Power.—As a prominent instance of the superior economy of water power in favorable localities, with economically constructed plant, the rates published for the new hydraulic tunnel are for 5,000 HP. or over, $10 per HP. per year; 4,500 HP., $10.50; 4,000, $11; down to small powers of 300 HP., $21. On the old hydraulic canal, powers have been leased as low as $4 for 600 to 1,000 HP., and $5.30 for 250 to 300 HP. It is now proposed to furnish Buffalo with power at about $18 per HP., which now costs at least $50 for steam.

Commercial Value.—Lowell, with 4,085 sq. miles basin, worth, properly reservoired, at 50%, 7,112 cu. ft. per second, actually has sold and maintained as regular powers, 139.36 mill-powers, about 11,149 HP. "penstock," and 8,363 "shaft," for which the rental value is about $1,200 per year per mill-power, which is 6% interest on $20,000 capital, or $2,787,200 for the whole power. In addition, there is a large sale of extra powers.

Lawrence, with 4,553 sq. miles basin, worth about 9,000 cu. ft. per second, uses about 2,400 cu. ft. (24 hours mean), and with 180 mill-powers now controlled, has maintained and sold 122, about 7,320 HP. "shaft," worth, at 6%, $2,440,000; and has also sold an average of about 20 extra powers, about 7 months' use, payment $1,280 (or $2,194 per year), or $21,336 at 6%; value, $731,540; in all, $2,866,720. In addition, there is a land income which makes the value of these powers about $35,000 to $40,000 each. Controlling 180 mill-powers of 30 cu. ft. per second, or a mean per day of 2,700 cu. ft., with a rainfall of 15,050, it can actually sell 18% of this mean supply on the entire basin without careful flood storage.

Anchor Ice.—In very cold weather the surface particles are reduced more or less below freezing temperature, and coming in contact with iron bars, valves, etc., a rapid accumulation of needle ice takes place when the stream surface near them is thus exposed; but when the current for some distance is protected from the air, the temperature is kept above freezing, and this action is prevented. One sees in the races, above the mills in Maine, several hundred feet of floating, light, wooden frames, intended to promote ice formation and prevent this surface-motion exposure.

At Caratunk Falls, the reach above the dam freezes for two miles up stream, with blue ice 24 ins. thick, in winter; above this the stream is obstructed by anchor ice, as it is below the falls, with an open stream, but this ice sheet effectually prevents it, and this suggests a valuable remedy for a very serious trouble on various rivers and races.

RESEARCHES IN FIRE PROTECTION OF FACTORY BUILDINGS.

The Boston Manufacturers' Mutual Fire Insurance Co. has recently issued three circulars to its members, which contain important information in regard to fire protection. We give some extracts from these circulars below:

Pump Governors.—Pump governors, so called, are designed to maintain a constant water pressure in the pipe system to which the pump delivers by opening the steam throttle valve to the pump whenever the water pressure falls below a certain point, and conversely to shut the steam throttle valve whenever the pressure rises above the said point. The Factory Mutual companies have never looked on these with favor, except as a last resort, and the experience obtained from year to year has led them to be looked on with even less favor, until now they are never accepted for controlling the primary supply to automatic sprinklers. Our inspectors have, in very many instances, found them incapable of operating in a proper manner after they had been in use for a year or more. In many cases it is found that to thus control a fire pump wastes steam to the value of a dollar or more per day, besides subjecting the pump to unnecessary wear.

Fire Hazard from Telephone Wires.—Professor Puffer has made special tests with the latest protectors of the American Bell and New England Telephone companies, which are designed to guard against the dangers of crossing of telephone wires by wires carrying currents of great capacities, at pressures varying from 500 to 2,000 volts. In all cases there was a report and a flash of fire when the protector operated. It seemed that if the protector was covered with fine lint, or near a light curtain or the like, the chance of causing a fire would be quite great, yet in most positions where likely to be used, there would be little or no danger from the flash of the fuse. The protectors are much alike in design, that of the New England Telephone Co. being rather the better. Though some improvements are still desired in both protectors, they are in their present shape so good that their immediate use is advised and believed necessary for safety on all telephone wires.

When we come to the great class of private wires for bells, watch clocks, telephones not the property of the American Bell Telephone Co., but often running out of doors where subject to contacts with high-voltage wires, it is easy to find the greatest risk of fire, because there is usually no attempt to make use of protectors of any kind. There being no demand for such a thing, there seems to be but very little offered by the trade.

The best remedy is to so run these wires wherever possible that they could not fall on, or be fallen upon, by foreign wires of any kind. It may be noted that any foreign wire may be dangerous, though nominally carrying a harmless current, as it may itself be in contact with a high-voltage wire. When wires cannot be completely isolated, protecting devices equal to those of the telephone companies are necessary for safety, and should be used as soon as something satisfactory can be developed.

Fire Retardents on Wooden Surfaces.—Tests have been made by Mr. Chas. L. Norton of several materials which can be made use of on the under side of roofs and in many places where it would either be very difficult to plaster on wire lathing or on expanded metal, or where the process of plastering with wet mortar might make serious interruption to the conduct of the work, with perhaps some danger of damage to stock.

The object of these tests has been to determine the relative value of materials which can be put up without being subject to the objections applying to plastering.

The specimens were in the form of sheets varying from 1-16 to ¼ in. in thickness. All were cut 7 ins. square, and each was applied to a piece of soft pine wood, 7 ins. square and ½ in. thick.

A series of tests was made, first, by exposing the specimens to a blast of heated gases at a temperature of 1,600° F. for ten minutes. The efficiency is estimated from the depth of charring in the wooden backing. A second test was made by exposing each specimen to the blast at a temperature of 2,400° F. until the backing caught fire. The efficiency is rated on the time elapsing before ignition. The temperatures were determined by a Le Chatelier pyrometer. The following table gives a list of the materials in the order of their efficiency, as shown by the tests:

No.	Material.	Grade.	Depth of charring.	Minutes before ignition.
1.	Salamander	No. 4	0	14
2.	Wall board	Cement finish	0	8
3.	" "	Plaster finish	0	8
4.	Fire felt	¼ in.	0	7
5.	Salamander	No. 3	1-16 in.	5
6.	Wall board	Plain	¼ "	5
7.	Air cell	3-ply	½ "	4½
8.	Wall board	Fancy	½ "	4
9.	Fire felt	¼	¼ "	3½
10.	" "	3-32	.....	3

Nos. 1 and 5 were from the American Fireproofing Co.; Nos. 2, 3, 6 and 8, from the Sackett Wall Board Co.; Nos. 4, 9 and 10 from the H. W. Johns Mfg. Co.; No. 7 from Asbestos Paper Co.

The time required to ignite the several specimens of the same material rarely varied more than ten seconds, and this may be considered a fair average deviation from the mean time required.

All the materials were virtually ruined after the tests. From 5 to 15 specimens of each material were tested. Care was taken to eliminate the effects of any slight progressive change in the furnace conditions by repeating each series in reverse order.

The reduction in price per ton for building our new navy is pointed out by Secretary Herbert in his annual report. The gunboats "Machias" and "Castine," contracted for in 1890, cost $302.86 per ton, while the average price of the three gunboats contracted for in January, 1894, and the six others just awarded, was $222.34 per ton, a saving of $80.52 per ton, or 26%. The torpedo-boat "Ericsson," contracted for in October, 1891, cost $945.83 per ton. The average for the six torpedo-boats let in 1895 is $766.58 per ton, a reduction of about 20%.

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AND

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It is the established policy of this journal to take no part in the discussion of purely political or partisan questions. But the results of the public discussion of such questions often become proper topics for consideration here. During the last 10 days the possibility of a war with England has been precipitated upon the country, and in the excitement which greeted the President's message and some of the inflammatory speeches in Congress, very many things were said, and reached publicity in the daily press, which had far better have been left unsaid. The stock market panic which followed has at this writing apparently spent its force; and the indications are that a wiser and more moderate temper is prevailing in the consideration of the questions in dispute on the part of both countries.

War between England and the United States would be a terrible calamity to both, and indeed to civilization itself. The best sentiment in both countries is, we believe, opposed to any recourse to arms to settle diplomatic differences. It is fortunate that the course now decided upon makes necessary a considerable delay before any more serious action can be taken; and it is to be hoped that during this delay the conservative sentiment in both countries may make itself felt in no uncertain way. So far as mere money matters are concerned, either nation could well afford to buy the whole of Venezuela a half dozen times over and present it to the other, rather than enter upon the uncertainties and enormous outlays of war. The humanitarian and economic aspect of the question must appeal also to every thinking man; and no words of condemnation can be too strong for those who from pure malice or from motives of cupidity seek to fan the flame of international discord.

The experiments on the comparative heating power of different steam-heating radiators, described in another column, seem to admit of at least one definite, but somewhat general conclusion, that the simpler types of radiators are most efficient, that is, they radiate the most heat per square foot of total radiating surface, and that the addition of ribs or corrugations to the surface, producing what is called "extended surface," decreases the radiation per square foot of total surface, although it enables a greater amount of surface to be furnished in a given space or at a given cost than can be done with the simpler or unribbed types. For example, the addition to the plane surface of 43% of extended surface increased the amount of heat radiated only 15.2% in one test and 19.9% in another. The experiments at Richmond and at the Stevens' Institute, while they show quite satisfactorily the relative value of the particular heaters tested, might very well be supplemented by further work aimed to show the best possible form of radiator for giving a free outlet to the heat from condensing steam. The methods employed in the tests under discussion were probably sufficiently accurate, as comparative results alone were sought. If the absolute value of the heating power of each radiator were required, however, as would be the case in such a series of extensive tests as has just been suggested, errors of an indeterminate amount would be introduced by using the methods which have been described. The radiator should be protected from the influence of the varying conditions of draft in a room subject to the influence of the outside air. The mutual effect produced in the Richmond method by the five radiators in close proximity would prohibit its use for an absolute test. The correction for condensation of steam in the outlet pipe and receiver is a necessary accompaniment of the method which depends upon the measurement of the condensation of steam. While this correction may be accurate, its determination destroys the continuity of the tests, since the pipes must be disconnected from the radiator, allowing it to cool and requiring a half-hour for its re-heating, preparatory to the next test.

In the convection tests at Richmond the radiator was surrounded by a box, surmounted by a short chimney, for the purpose of diverting upward the heated air given off. An anemometer was placed in the chimney for the purpose of measuring the rate of flow. Were it possible to accurately measure the quantity of heated air given off, and were its temperature uniform, it would be possible to determine the number of heat units given off per hour by the radiator, and to check in this way the condensed water record. Of course any reliable determination of the quantity of heated air given off would be practically impossible. It occurs to us, however, that the amount of heat given off by a radiator might be measured with great accuracy in the following way: Enclose each radiator in a specially-constructed air-tight water-jacket of simple construction, completely surrounding it. Insulate all connections near the radiator to reduce the loss by conduction to a minimum. Water from the mains may then be run through the jacket and the rate of flow be so adjusted as to keep the temperature of the discharged water the same as that of the room. The temperature of inlet water and the amount used would be the only other data required to determine the total heat given off. At the least, this method might give a useful check upon the heat measurement furnished by the condensation.

In the United States, reservoirs for storing water are usually constructed of earth embankments, lined with puddle, concrete or brickwork. They are uncovered, and are comparatively inexpensive, and in design and in construction it is generally and unfortunately believed that no very high degree of engineering skill and experience is required in most cases. But these reservoirs invariably leak more or less; and while this leakage often means little more than a waste of water, which has been pumped at some expense, failures due to this cause do often occur, and sometimes with very serious results. In Europe the practice in reservoir construction is very different. There storage reservoirs are often located within great cities, where the land is costly; the authorities require them to be covered, to avoid contamination of the water, and the surroundings are such that the largest volume of water possible must be stored upon the least base area. Under these controlling conditions the use of masonry is imperative, as earth walls are unavailable and would practically be more expensive in the land necessarily occupied by the embankments. It is the usual practice to locate these reservoirs as much as possible in an excavation, and to cover them, for the purpose of protecting the masonry from atmospheric influences tending to crack the walls and bottoms, and to preserve the stored water at a low temperature and free from the effect of sunlight and local rainfall. But in spite of all the precautions taken, it is impossible to prevent a certain variation of temperature and the consequent expansion and contraction cracks tending to produce leakage. On certain soils this leakage might result in very dire consequences, and the paper of M. Dutoit, elsewhere given in this issue, well illustrates the important nature of the precautions deemed necessary by European engineers to guard against the effects of leakage. M. Dutoit wisely assumes that, with the greatest caution in general design and construction, leaks will occur in the confining walls or bottom of the reservoirs, and he therefore provides means for gathering this escaping water and conveying it to points where it can do no harm to the underlying, treacherous soil. The double bottoms, accessible galleries, groined arches and impermeable lining and drains are very costly when compared with our simpler practice. But when we consider the nature of the site—in the case of the Montmartre reservoir in the heart of Paris—the very expensive outlay in the superincumbent work, and the probable result of a break in this reservoir, it must be admitted that all these precautions are necessary and wise, both from an engineering standpoint and from that of the civic authorities who pay for construction, and would have to pay for the consequence of failure due to a lack of these precautions. It is one of the cases more often found in European practice than in our own, where every consideration of cost is sacrificed to security as absolute as human intelligence and experience can make it. Some of the methods used in stopping leaks in concrete will be new to many of our readers, especially where pure, unvulcanized rubber is employed in connection with cement mortar. But it must be considered that this French practice is founded on an experience wider than our own in this connection, and the hint may be valuable in other fields.

It is seldom indeed that Engineering News has to ask the indulgence of its readers on account of matters pertaining to the mechanical work of its publication. During the past week, however, we have been obliged to move our composing rooms, and this, in combination with the occurrence of the Christmas holiday, has obliged us to delay for 24 hours our date of going to press, and to change to some extent the typographical appearance of the paper.

WHAT DOES WAR MEAN?

In casting about for some topic more appropriate to the Christmas season than the matters of technical interest ordinarily discussed in this column, it has seemed to us that a topic which may have some especial appropriateness at this time, is the real concrete significance of the term war at the present day.

Words change their meaning with the progress of the world. "Travel," for example, a century ago meant laborious and toilsome journeying on horseback or by stage coaches, or at sea by sailing vessels, and was attended always with more or less of hardship and often of danger. At the present day "Travel," by reason of the countless multitude of conveniences and comforts with which modern engineering has surrounded it, has come to have an entirely different significance. Instead of being a hardship, undertaken only under pressure of necessity or by bold and venturesome spirits, it has come to mean one of the chiefest of modern luxuries, and a necessity of everyday life.

So with the word "War." It meant one thing in the days of the Crusaders. It meant an entirely different thing when the North and the South joined issues in the bloody struggle that closed thirty years ago. What would it mean at the present day when smokeless powder, magazine rifles, high explosives, machine guns and all the countless death-dealing appliances which the last score of years has developed would be applied to its prosecution?

It is a fact and a most important one, that no one knows positively what war between two of the world's great civilized nations would mean at the present day. Inventions in the other departments of industry are put into use as soon as made. The world adapts itself to the changes which electricity and steam are constantly making in industrial and social life. But the inventions relating to warfare have for years been accumulating, while the

long duration of peace among civilized nations has kept them unused, for the most part, for many years. It may be said that the European nations have had occasional brief conflicts with barbarous or semi-civilized tribes in Asia and Africa, and that some knowledge was gained in professional circles through the events of the Japan-China war. But it is, nevertheless, broadly true that no one knows what a war at the present day between any two of the world's great powers would actually be.

This fact is certainly an unfortunate one. It has often been prophesied that the progress of invention would make war so destructive that no nation would dare to venture upon it; and to one conversant with the improvements made in weapons of warfare during the past score of years, it would seem that a long step has already been taken in that direction. But neither the statesmen who guide the affairs of nations, nor the people at large, in whose hands the ultimate power resides, appreciate the revolution which has taken place in the instruments and methods of warfare. It may be that some stupendous struggle between two great civilized nations may yet be necessary in order to furnish to the world an impressive object lesson of what war with the weapons of the present day involves.

Let us take a concrete example of the change which modern weapons have wrought in the art of warfare.

The cavalry charge has always been a thrilling feature of great battles; and has been celebrated in song and story more than any other incident of battle. It will probably surprise many to learn that there will be few charges either of cavalry or infantry in the battles of the future. The success of a charge always depends on the ability of the moving troops to cross the danger space and reach the enemy's lines without losses serious enough to check the advance. There has been an enormous increase in the rapidity and effectiveness of infantry fire in the past ten years, or even the past five. The danger space is now so wide, the possibilities of rapid firing are so great, and the killing power of the bullets so terrible, that neither cavalry nor infantry could now reach intrenched troops without being annihilated. The famous charges of history will not be repeated in future wars, or if repeated the result will be the total destruction of the attacking party. Tennyson's "Six Hundred" at Balaklava sent by mistake "into the jaws of hell," rode back again; "but not, not the six hundred." Had that battle been fought with present day weapons not only would none of the six hundred ever have ridden back, but none among them would ever have reached the objective point where the turn was made.

We may even go further and say that the science of handling troops upon a battlefield must be entirely revolutionized to suit modern weapons. The infantry rifle enables a soldier to fire a hundred rounds of ammunition in four minutes. The bullets will kill at a range of between one and two miles, and at point blank range will penetrate sixty pine boards each 1 in. thick. Besides this, light field machine guns can pour forth a perfect hail of missiles with unerring aim. A light-weight Maxim gun, weighing only 25 lbs., can fire 600 to 700 shots per minute with an effective range of two miles. For the latest improved Gatling gun, with electric motor, 1,800 shots per minute are claimed. Heavier field pieces of longer range can deliver 25 to 30 6-lb. shots per minute.

It is evident enough from these figures that to manœuver masses of troops upon a battlefield within sight of an enemy will be to invite their annihilation. As soon as troops come in sight of each other active firing will begin, for were either side to wait till it reached closer quarters it would be pretty certain to suffer heavy losses. Battles in any open country must be fought at long ranges, but even then the facilities will probably be far greater than in the worst conflicts of the Civil War.

The enormous velocity of the modern projectiles will have a marked influence upon the fatalities of any future war. A bullet which will penetrate 60 1 in. pine boards will require heavy earthworks to protect troops, and field intrenchments cannot be made to afford protection with such rapidity and facility as in past wars. More important still, in firing against troops formed in mass, a single bullet may frequently kill several men. With the old ammunition, in countless cases, the soldier in the front rank fell, while the man behind him escaped unhurt.

Some difference of opinion has existed as to whether the small caliber projectiles of the modern small arm are as fatal as the old-fashioned bullets. Recent investigation appears to show, however, that the enormous velocity and rapidity of rotations of the new bullet, with the tendency of the lead to squirt from its metallic envelope on striking an obstacle, make the new bullet much more fatal than the old.

There would appear to be little doubt from the above facts that future great battles between opposing armies will be scenes of carnage far worse than the bloodiest fields of the Civil War or of the Franco-Prussian campaign. Let us next inquire whether the chances of those who man the ships of war are likely to be any better. When the first ironclad vessels were built it was believed that naval warfare henceforth was likely to be a comparatively safe business for those engaged in it. But with further progress in the building of guns and the use of torpedoes, the risks of naval warfare have become quite as great as those on land. The naval conflicts in the late Japan-China war showed that the pounding of an ironclad by an enemy's projectiles may do serious injury to the crew without greatly endangering the vessel herself.

The most important new element in naval warfare is doubtless the use of high explosives. It is now possible to fire from ordinary guns shells charged with high explosives; and it is believed that these will be extremely effective in the bombardment of land fortifications or cities.

But while the offensive powers of the modern war vessel have thus been increased, the high explosives at the same time constitute the greatest danger to which modern battle-ships are subjected. Torpedoes of the automobile class have already proved their powers of offense in the Chilean and Japanese wars, and these, with sunken mines and floating torpedoes will probably prove a chief source of fatality to naval vessels engaging in coast attacks in any future war. In fact, it is quite possible, if not indeed probable, that the present floating fortresses on which the nations of the world chiefly base their naval strength, will be rendered obsolete in a very few years by the advance in the use of high explosives. The mightiest ship afloat is, and must of necessity be, extremely vulnerable below its water line. A few dollars' worth of dynamite will sink the most powerful vessel if exploded in contact with its hull. It needs but the perfection of a submarine boat capable of placing such dynamite charges to make all the great battle-ships of the world almost absolutely worthless.

It is instructive to note, further, that war at the present day is quite certain to be vastly more costly than the wars of past decades. A single great battleship, when equipped ready for action, may cost four or five million dollars, as much as a whole fleet cost in the days of sailing vessels. All the complicated machinery of modern warfare, in fact, is not only enormously expensive, but is more liable to derangement and destruction than the cruder weapons of earlier days. The pay of troops, again, will doubtless have to be on a more liberal scale in any future war, unless compulsory enlistment is adopted, and all governments will put off that measure as long as possible. No estimate of the events of future wars will be complete that does not take into account the great change in the condition and position of labor that has taken place within two decades. We may be sure that it will be insisted upon in any future war that the soldiers and sailors who go out to risk their lives in their country's service shall receive pay that would have been accounted out of the question a generation ago. It must also be borne in mind that the expense of any future war is likely to continue for many decades after it. During the Civil War the United States spent a million dollars a day in the prosecution of the war, but thirty years after the war's close its pension payments approach half this sum. Inasmuch as future wars are likely to be much more fatal to those engaged, the pension bill to follow will be great in proportion.

It is sometimes urged that dollars should not be considered when "national honor" is concerned, but no really broad thinker can take such a view. The fallacy that is embodied in it is not dissimilar to that which kept alive the custom of dueling long after civilization had outgrown it, or which perpetuates neighborhood feuds among the Southern mountaineers. Let us not forget that dollars stand for education, philanthropy, industrial and social improvement of every sort. One important reason for the wealth of the United States and the higher wages and easier conditions under which the masses of her people live, is that the tax burdens are trivial here compared with what they are in European nations, loaded down with their heavy national debts, and the expense of maintaining their great armaments.

We have shown the reasons why war at the present day is likely to involve far greater outlays of blood and treasure than any wars of preceding generations. It is also extremely probable that the injuries which war would bring upon the industrial world would be greater far than in past times. During the past quarter century an enormous increase has taken place in the use of credit as a medium of exchange, and the great improvement and cheapening in transportation facilities, has doubled and quadrupled or multiplied even more greatly the volume of trade, both domestic and international. The effect of both these things is to weave a net of interdependence throughout the civilized world. Each community, each section, each nation has its prosperity bound up with the fortunes of its neighbors in a way that was never before known in the history of civilization. Any interruption to the circulation of commerce, either its arteries, the railway and steamship lines, or its veins, the system of commercial credits and the currency, is at once felt the world around. Time was when one nation could look on undisturbed while its neighbors engaged in strife; but that is the case no longer. At the present day, it is true that if one nation suffers, all the others, to a greater or less extent, must suffer with it. Only a few years ago financial disaster in one insignificant South American republic made an era of hard times that was felt to a greater or less extent all over the world.

In the "North American Review" of the current month, Prof. N. S. Shaler of the Lawrence Scientific School ventures a prophecy that the "last gift of this century" may be the establishment of some international tribunal whose object shall be the settlement of international difficulties without recourse to arms. He points out that future historians will wonder why the nineteenth century accomplished so many great things for the amelioration of the human race, and yet left war, the greatest of all human ills, quite untouched. Every thoughtful student of human affairs must certainly hope that the prophecy of the distinguished scientist and engineer will ultimately be fulfilled, even though the fulfilment may be delayed until the next century has begun or is well on its course.

It is the work of the nineteenth century engineers that has made war so destructive to human life and so severe a tax on the world's wealth. It is the work of engineers, also, that has tied the world together with such close bonds of intercommunication and peaceful traffic that the effects of war are more far-reaching than ever before. It can hardly be doubted that in thus increasing war's destructiveness and horror, engineers have really wrought for that ultimate "peace on earth," whose prophecy the Christmas season celebrates.

LETTERS TO THE EDITOR.

LIST OF ERRATA IN KENT'S "MECHANICAL ENGINEER'S POCKET BOOK."

Sir: We beg to announce that we have issued an errata slip for Kent's "Mechanical Engineer's Pocket Book,' which will be sent free to any address upon application. Yours truly,

John Wiley & Sons.

53 East 10th St., New York, Dec. 14, 1895.

A HISTORY OF ENGINEERING.

Sir: Some years ago when "engineering editor" of a college paper in a Western state university, I received a short note for publication from one of the professors in which he lamented that the history of engineering had never been written, and it has often occurred to me since that it is indeed to be deplored that, although we have histories of almost everything else, we have none of engineering, except in disjointed fragments. That engineering, whether as a ancient art or a modern science, has a history, and an exceedingly remarkable and interesting one, I believe, is agreed by all engineers. A lecture delivered last year by a prominent American engineer before the students of an Eastern

engineering school on the supply and distribution of water in ancient Rome, and a recently published work on the development of modern transportation facilities by a noted English authority, are proofs, if any be needed, of the peculiar, interesting and instructive nature of the subject, and also of the vastness of territory and time over which it extends.

To write a comprehensive history of engineering would certainly be a great undertaking, but few persons will doubt that it can be accomplished. It would require unusual intelligence and knowledge, much time and material resources, but it would not necessarily be an unprofitable task, as there undoubtedly is a demand for such literature, which in time would be largely increased. The history of architecture is now taught in the schools of that profession, and the history of engineering should be taught in like manner, and no doubt would be, if suitable literature were available, because it would be a valuable educational agent and would afford useful instruction. Practical and scholastic knowledge, time and money, are necessary, but all these requisites are to be found inside the engineering professions—the oft-told tale of overworked and underpaid engineers notwithstanding—and some assistance might be expected from publishing houses.

Perhaps, the eminently able Society for the Promotion of Engineering Education will take the matter in hand. If it be pertinent for me to make a suggestion to so august a body, committees might be appointed to outline courses of study for the various branches of engineering, and an attempt be made to include these courses in the advanced curicula. Should this prove successful, the material for a comprehensive history would gradually accumulate from the researches of existing literature and from travel and observation. Whoever undertakes the task, it is safe to say, will earn the gratitude of the engineering professions, and probably a fair pecuniary remuneration.

Yours truly, P. M.

Hamilton, Ont., Dec. 7, 1895.

(We fear that most engineers are so busy making history that they have not time to write it,—or even to read it.—Ed.)

NOTES AND QUERIES.

H. A. asks: "Does the corporation renting the Toronto street railways pay a tax on its capital stock; if so how much?"

The contract between the city of Toronto and the Toronto Street Railway Co. provides that all the property of the company liable to taxation for school purposes shall be so assessed, and taxes assessed shall be payable into the school fund. Through the kindness of Mr. C. H. Rust, Deputy City Engineer, we have learned in addition to the above that the company, as such, pays no tax upon its capital stock. The shareholders are taxed upon the amount of income received in dividends by them upon the shares of stock they hold, and this only applies to the resident shareholders and not those living outside the city. The real estate and other real property of the company is subject to assessment the same as other property of like description in the city. The company, we may add, does not rent the street railway property. It bought that from the city, and the sums named in our issue of Nov. 7, 1895, as paid by the company into the city treasury, is a rental fee for the franchise.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Proof of Survey—Accuracy of Measures.

Where a surveyor testifies that his measures conformed to the United States standard, but refused to say that they conformed to the standard of the state, it is not a compliance with the law (of New York), which prohibits surveyors from testifying as to a survey made by them, unless they make oath that the measures used by them were conformable to the standards of the state at the time such survey was made.

Justice White, of the Superior Court of Buffalo, said: "From such examination as I have been able to make, I can find no decision holding that the oath of the surveyor was a sufficient compliance with the statute, and on principle I am now satisfied that it was not. The statute plainly contemplates a comparison of the measure used by the surveyor with the standard of the county, to be certified to by the sealer of weights and measures in the manner pointed out in the statute."

Duty of Gripman on Street Car.

The gripman of a cable street railway is not required to stop or check the car on seeing a pedestrian approaching the track, as he has the right to assume that the pedestrian will use reasonable precautions to avoid danger; but when it is apparent that the pedestrian is about to place himself in danger, he must use every possible effort, consistent with the safety of the passengers, to avoid injury to him.—Bunyan v. Citizens' St. Ry. Co. (Supr. Ct., Mo.), 29 S. W. Rep., 842.

Liability for Defective Drain.

Where a lot owner knows that his premises will be flooded in case of a heavy rain unless a certain city drain-pipe in the adjacent street is cleaned out, and gives no notice of it to the city, and makes no effort to remedy the defect, he cannot recover of the city damages caused by flooding his premises during such a storm.—Parker v. City of Laredo (Ct. Civ. App., Tex.), 28 S. W. Rep., 1048.

Patents on a Process and on an Article of Manufacture.

That certain processes of manufacture are patentable is as clear as that certain others are not, but nowhere is the distinction between them accurately defined. There is somewhat of the same obscurity in the line of demarcation as in that between mechanical skill and invention, or in that between a new article of manufacture which is universally held to be patentable and the function of a machine, which it is equally clear is not. It may be said, in general, that processes of manufacture which involve chemical or other similar elemental action are patentable, though mechanism may be necessary in the application or carrying out of such processes, while those which consist solely in the operation of a machine are not. Most processes which have been held to be patentable require the aid of mechanism in their practical application, but where such mechanism is subsidiary to the chemical action, the fact that the patentee may be entitled to a patent upon his mechanism does not impair his right to a patent for the process, since he would lose the benefit of his real discovery, which might be applied in a dozen different ways, if he were not entitled to such patent. But, if the operation of his device be purely mechanical, no such consideration apply, since the function of the machine is entirely independent of any chemical or other similar action. It is equally clear, however, that a valid patent cannot be obtained for a process which involves nothing more than the operation of a piece of mechanism, or, in other words, for the function of a machine. . . . This is a patent only for superior workmanship, and within all the authorities is invalid. This court has repeatedly stated that all improvement is not invention. If a certain device differs from what precedes it only in superiority of finish or in greater accuracy of detail, it is but the carrying forward of an old idea, and does not amount to invention. Thus, if it had been customary to make an article of unpolished metal, it does not involve invention to polish it. If boards had heretofore been planed by hand, a board better planed by machinery would not be patentable, although in these cases the machinery itself may be patentable.—Philip Medart v. Risdon Iron & Locomotive Works, U. S. Supreme Court, decision by Justice Brown, April 22, 1895.

Mandamus to Operate Street Railway.

A petition averring that a street car company was duly incorporated and authorized to construct a street railway line, and that it constructed a line between the city and certain suburban property, but that it has since abandoned it, in violation of its duties and the rights of the parties filing the application, who are citizens and owners of property in such suburbs, and praying mandamus to compel it to resume the operation of such line, is sufficient to authorize the issuance of such writ.—State v. San Antonio St. Ry. Co. (Ct. Civ. App., Tex.), 30 S. W. Rep., 266.

Damages for Changing Grade of Street.

In an action by an abutting landowner against a street railway company for damages for changing the grade of a street in front of his land, the measure of damages is the difference in value of the premises before and after the change was made.—May v. Carbondale Traction Co. (Supr. Ct. of Pa.), 31 At. Rep., 667.

Bona Fide Purchaser of Bonds.

The burden of proof is on the purchaser of municipal bonds, who had notice of facts sufficient to put him on inquiry as to their validity, to show that he exercised reasonable diligence in making inquiry. The failure to follow up information reflecting on the issuance, in their possession, is in law inconsistent with good faith and want of notice.—Ball v. Presidio County (Supr. Ct. of Tex.), 29 S. W. Rep., 1042.

Street Railways Must be Built According to Ordinances.

The Supreme Court of New Jersey holds that where an ordinance of a borough required a city railway company to lay its road within the municipality in a certain manner, and the company duly accepted such ordinance under its corporate seal, and afterwards refused to comply with the provisions, it will be compelled to perform its duty in that regard, and a writ of mandamus will lie. Where several different lines and companies consolidate, the franchises are not enlarged, but each is subject to the original conditions and limitations of the individual lines.—State v. Trenton Pass. Ry. Co., 31 At. Rep., 238.

Location of Street Railway.

While a street railway may diverge from a street a short distance, where it is necessary to avoid discomfort or danger to the traveling public, it cannot, to reduce time and distance for passengers traveling from city to city, locate its route across country.—Rahn Township v. Tamaqua & L. St. Ry. Co. (Supr. Ct. of Pa.), 31 At. Rep., 472.

Construction of Street Railway on County Bridges.

A bridge owned by a county cannot be occupied by a street railway company without the consent of the county commissioners; and while their consent cannot be arbitrarily withheld, they may refuse to allow it to be used till made strong enough for the additional burden, and may require the company, as a condition of its occupancy of the bridge, to pay the cost of the necessary work and of repairs.—Berks County v. Reading City Pass. Ry. Co. (Supr. Ct. of Pa.), 31 At. Rep., 474.

Liability of City for Negligence in Obstructing Streets.

A city which allows an obstruction to remain in a street for an unreasonable length of time will be liable for injuries caused by it, to the same extent as if it had originally placed the obstruction in the street. The piling of lumber in a public street, prima facie, constitutes negligence, and the city is liable for injuries caused, although it did not know that it was piled in a dangerous manner.—Senhenn v. City of Evansville (Supr. Ct. of Ind.), 40 N. E. Rep., 60.

Municipal Officers Must Not Deal with Themselves.

A contract was made between the trustees of a town and A and two associates for the supply of the town with water, three out of five trustees being present and participating in the making of the contract. One of these three trustees was jointly interested with A and his associates in the subject matter of the contract. The circuit court of the United States held that such contract, both by the common law and by the statute of California (where the town was situated), prohibiting a trustee from contracting with himself, was absolutely void.

After the passage of the ordinance by which such contract was made, the legislature passed an act approving and ratifying the same, the fraud, however, not being disclosed to the legislature at the time. It was held that though the legislature could cure irregularities and confirm proceedings which without confirmation would be void as unauthorized, it did not by the passage of such act ratify the undisclosed fraud.—Santa Ana Water Co. v. San Buenaventura, 65 Fed. Rep., 323.

Part Performance of Waterworks Contract.

Where a contract by which a water-works company agreed with a city to furnish water for domestic and public purposes, and also to keep a designated number of hydrants constantly supplied with water under sufficient pressure for effective fire service for a term of years, has been substantially performed as to the first-named purpose, but not as to the latter, and the city has voluntarily accepted and received the benefit of its performance as to the first part of the contract, knowing that the contract was not being fully performed as to the last-named part, it is precluded from insisting upon a performance of the residue as a condition precedent to its liability to pay for what it has received, and must rely upon its claim for damages as to the part not performed.—Sykes v. City of St. Cloud (Supr. Ct. of Minn.), 62 N. W. Rep., 613.

Rights of Abutting Owners to Highway.

As abutting owners on a highway own the fee, subject to the easement for road purposes, which do not include the building of a pipe line along it for conducting natural gas, and thus supplying it to the public, the legislature cannot authorize such a gas company, though engaged in a public enterprise, to so construct its line without making compensation to the abutting owner. And where such company lays its line along a highway without having obtained the right by condemnation or by consent of abutting owners, such an owner may tear up and remove the pipes in front of his premises.—Consumers' Gas Trust Co. v. Huntsinger (Appellate Court of Ind.), 39 N. E. Rep., 423.

Unauthorized Change of Street Grade.

Where an unauthorized change of grade is made by the agents of a city it may adopt and ratify the work, and recover the expense of the owners of the property benefited. The city having the undisputed power to establish grades and to make contracts for paving, the correlative power of adopting grades and contracts, made by its officers for its own benefit, necessarily follows. It may ratify the unauthorized acts and contracts of its agents or officers which are within the corporate powers, but not otherwise.—In re Grading of Shiloh St., 30 At. Rep., 986.

Grant of Franchise by City Officers.

If a city council, in bad faith, and as a matter of favoritism, grants franchises to a person for less than could be obtained from another, such act is within the statute authorizing taxpayers to sue city officers to prevent waste of city property. If such council granted franchises for a part only of the compensation which it was authorized to exact, without any endeavor to secure greater, and without giving any opportunity to competitors to bid for such franchises, a prima facie case of waste of municipal property is made.—Adamson v. Nassau Electric Ry. Co. (Supr. Ct., Special Term, Kings Co.), 33 N. Y. S. Rep., 732.

THE UTILIZATION OF ANTHRACITE CULM AT SCRANTON, PA.

(Editorial Correspondence.)

Not many years ago the anthracite coal mines shipped to market no size of coal smaller than chestnut, or coal which would not pass through a ⅞-in. screen. All that went through the screen, including all the remaining sizes down to fine dust, was wasted and carted to the culm pile. About 30 years ago it become common to separate the pea coal, which passed through a ⅞-in. and over a 9-16 or ⅝-in. screen. Later the buckwheat, passing through a ⅝ and over a ⅜-in. screen, and more recently still, finer sizes, known somewhat indiscriminately as No. 2 buckwheat, barley, rice and bird's-eye, were separated and shipped, leaving only that which would pass through a ¼-in. screen to go to the culm pile. The old piles of culm existing throughout the anthracite region vary considerably in the sizes and qualities of fine coal they contain in addition to the actual dust. It is said that in some piles the dust is actually purer than the average coal, for in crushing the coal in the breaker it is the good coal that breaks more easily into dust, while the slate remains in lumps and is picked out by the slate boys in the breaker more or less completely from the large sizes that are shipped to the market, but remains in the chestnut, pea and buckwheat. The quality of the dust varies, however, with different mines, according to the nature of the bottom and roof, and some portions of the coal regions, such as the Lackawanna valley, claim to have better culm than their neighbors. The culm now made by most of the mines contains only the dust and such fine

particles as can go through a ¼-in., or even finer, screen. It is, however, all available for fuel, provided the furnaces are properly adapted to it.

Some of the old culm piles in the vicinity of Scranton are now being utilized by screening and washing, to separate the several sizes, as buckwheat, rice, bird's-eye, etc., from the dust and slate, and these sizes are shipped as merchantable coal. From the same culm piles the untreated culm is taken just as it lies, with the exception of picking out by hand large lumps of slate that are found in it, and used directly under the boilers. Where a manufacturing or an electric light and power plant can be located close to a culm pile, the cost of fuel is most insignificant, the transportation being effected by a simple arrangement of "flights" on a link belt, on the Link Belt Engineering Co.'s system, which conveys the coal to an overhead hopper in the boiler house, whence it is carried by gravity down pipes or chute to the floor in front of the boilers. Such a method of using culm direct from the pile may be seen at the plant of the Suburban Electric Light Co. The culm pile occupies a piece of very valuable real estate, so that not only is the fuel obtained at a very cheap rate—probably not over 10 cts. per ton—but the ground is reclaimed at the same time. The new culm now being made by the mines is, to a large extent loaded into cars and delivered alongside of the boiler houses of the manufacturers at a cost of from 25 to 35 cts. per ton. The Lackawanna Iron & Steel Co., which obtains culm from its own mines, charges itself a nominal sum of 10 cts. per ton for the culm it uses in its steel works.

The most common style of grate bar used for burning the culm is known as the McClave grate, and forced blast is supplied by a kind of steam jet, called the Argand blower.

A full description of this grate and blower has been published in a paper by Mr. Rufus J. Foster, in Vol. XX., of the "Transactions of the American Institute of Mining Engineers," and also in a catalogue issued by the manufacturers, Messrs. McClave, Brooks & Co., of Scranton. Fig. 1 is a sectional view of the grate, the right-hand half being shown in its normal position, and the left half with the finger bars raised, so as to cut the clinker. The two halves are operated by separate systems of levers, so that one-half of the grate can be cleared at a time. After raising the finger bars as shown, a reverse motion of the lever drops them to their normal position, when a portion of the ashes drops into the pit. The bars can also be operated by a slight shaking motion,so as to clear the grate of fine ashes which are not clinkered. These grates are made with different-sized meshes, to suit the various sizes of fuels, the smallest mesh being 3-16 in., and yet retaining all the air space necessary. Fig. 2 shows an external, and Fig. 3 a sectional, view of the Argand blower commonly used with the McClave grate. Steam is admitted into the brass tubular ring, from which it emerges in two-cylinder series of very small jets, one series parallel with the walls of the blower shell, and the other slightly convergent with its axis. The induced air current makes a strong blast, which can be regulated by the stop-cock admitting the steam, and also by the damper in the chimney, which controls the resistance to the entrance of the air.

Mr. D. B. Atherton, Secretary of the Scranton Board of Trade, in his last annual report, gives the following statistics of the use of culm in 1892:

For the first six months of 1892 concerns in Scranton employing 8,760 HP. used 394 tons of fuel per day of 24 hours. These were concerns with improved plants (boilers, engines, etc.), and those with unimproved appliances, employing 7,362 HP., used 450 tons of fuel per day of 24 hours. We, therefore, find that 844 tons of fuel produced 16,122 HP. each day. This fuel costs 25 cts. per ton delivered at boilers, or a total of $211 per day for the 16,122 HP., or 1.31 cts. per HP. per day, and for 300 working days the total cost of fuel per HP. per year to these concerns was $3.93.

These figures of Mr. Atherton will bear a little further analysis. Eight hundred and forty-four tons per day of 24 hours for 16,122 HP. equals a little over 19 HP. per ton. Assuming that the ton is 2,000 lbs., this is 83.3 lbs. per hour, or 4.37 lbs. of coal per horse-power per hour. This looks reasonable, for, while in a first-class modern steam plant, with good coal, well-proportioned boilers and triple-expansion engines, a horse-power may be produced from 1½ lbs. of coal per hour or less, yet with variable loads, as in iron mills and electric plants, and where no great amount of attention is paid to economy of fuel, as is always the case where coal is very cheap, an average rate of 4.37 lbs. of coal per horse-power per hour is quite possible. The actual value of the culm as fuel, in comparison with egg anthracite, is variously rated by users as from 70 to 90%. Mr. Wm. McClave, the inventor of the McClave grate, who should be good authority, rates No. 1 culm at 78% and No. 2 at 70%.

As to the actual cost of horse-power at Scranton,

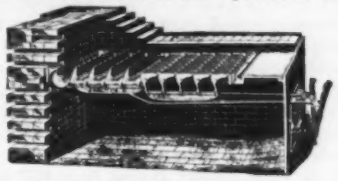


Fig. 1. The McClave Grate for Burning Fire Coal.

the following statement was given by Mr. Nelson W. Perry in "Cassier's Magazine" for November:

What is most important now is to arrive at the actual cost of a horse-power at Scranton under usual conditions of working. The data most available for this purpose are contained in some tests which were made under the supervision of a committee from the Scranton Engineers' Club. These tests were made under working conditions in two of the largest establishments in that city, and under other conditions which were intended to yield fair and unbiased results. As far as they go, I believe them to be thoroughly reliable.

In these tests the actual quantity of fuel used, and the quantity and cost of water and labor per HP., were carefully determined. I have used these data of actual practice, and in order to arrive at the total cost of power have estimated the fixed charges as follows: I have assumed that on account of the lower grade of fuel the boilers can only be pushed to 85% of their capacity with good coal. The boilers in the Lackawanna Iron & Steel Co.'s works are the Babcock & Wilcox

Fig. 2.

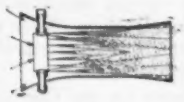


Fig. 3.

The Argand Blower, Used with the McClave Grate.

make, and estimated at $25 per HP. The actual cost of those in the Dickson Mfg. Co.'s shops, erected, is $16. We have, therefore:

Cost per HP. 24 Hours per Day for 365 Days.

	L. I. & S. Co.	Dickson Mfg. Co.
Boilers	$29.41	$18.82
Buildings and chimney	15.18	15.18
Engines, simple high-speed non-condens.	17.50	17.50
Total	$62.09	$51.50
Total, with 2½% for loss of interest during construction	$67.37	$55.88
Insurance, taxes and renewals, 5%, and interest on investment, 6%	$7.41	$6.15
Water	2.34	2.52
Firing	5.91	3.62
Removal of ash	2.45	.95
Total cost per annual HP., exclusive of fuel	$18.11	$13.24
Cost of fuel	4.94	8.30
Total cost per annual HP.	$23.05	$21.54

The above figures are for an annual HP. 24 hours per day and 365 days in the year. From these data I have calculated the cost of 10-hour power for 313 days in the year, assuming that the consumption of fuel for 10 hours will be 52.38% of that for 24 hours, and that the cost of labor and water will be 50%. The results are as follows:

Cost per HP. for 10 Hours a Day for 313 Days.

	L. I. & S. Co.	Dickson Mfg. Co.
Fuel	$2.23	$3.73
Water	1.00	1.09
Firing	2.54	1.55
Removal of ash	1.06	.42
Fixed charges	7.41	6.15
Total, without coal	$12.01	$9.21
Total, with coal	$14.24	$12.94

In the writer's opinion the figures given by Mr. Perry for the cost of power, exclusive of fuel, are too high. He assumes that on account of the lower grade of fuel the boilers can only be pushed to 85% of their capacity with good coal. He does not distinguish between rated capacity, such as 12 sq. ft. of heated surface per horse-power, and actual capacity in practice, which, with forced draft, is apt to be nearly or quite double the rating. From the high cost of boilers assumed this cost is probably figured on rated horse-power, and instead of assuming that the boilers would develop only 85% of this power, it would have been more in accordance with forced-draft practice to assume that they would develop 150% of their rating. The cost of boilers, buildings and chimney and engines are all unnecessarily high for present prices. Instead of $62.09 and $51.50 for cost of boiler and engine plant, we would consider $40 to be ample, figured on actual horse-power delivered by the engines. The figures given for removal of ash at the Lackawanna Iron & Steel Co., $2.45 per horse-power per annum for a 24-hour day, is surely a mistake. If 5 lbs. of coal were used per HP. per hour, and the coal contained 20% ash, the ashes for 1 HP. would amount to less than four tons per annum, and $2.45 would be an extravagant price for its removal. A revised estimate might be made, taking our estimate of the cost of plant, Mr. Atherton's estimate of the cost of fuel and the Dickson Mfg. Co.'s prices for the other items, as follows:

Interest, insurance, taxes and renewals on boiler and engine plant, 11% on $40	$4.40
Water	2.52
Firing	3.62
Removal of ash	.95
	$11.49
Cost of fuel	3.93
Total cost per annual HP. for 24 hours per day, 365 days in the year	$15.42

For a 10-hour day, 313 days in the year, the estimate will be:

Interest, insurance, etc.	$4.40
Water	1.09
Firing	1.55
Removal of ash	.42
	$7.46
Fuel (say, 12 hours, to allow for banking fires)	1.93
Total	$9.39

There are few places in the world where water power can be obtained as cheaply as the above figures, when interest, sinking fund, etc., on cost of dam, raceways, wheels, etc., are considered.

Much has been written concerning the cheap cost of power at Niagara Falls, and Scranton is advertising itself as a competitor of Niagara. Mr. Perry's article gives an estimate of the cost of power to the consumer at Niagara, assuming the price charged by the Niagara Falls Power Co. for the power delivered in the shape of electric current at $20 per horse-power, and adding to it interest on cost of transformers, motors, building, labor, etc., required to convert it into utilizable form. He arrives at the figures of $24.54, $25.83 and $27.26, using different assumptions as to efficiency of apparatus. Very much lower figures than these have been published elsewhere, however, concerning the cost of power at Niagara. For instance, Mr. Samuel McElroy's paper, an abstract of which was given in our issue of Dec. 5, gives the rates published for the new hydraulic tunnel as follows: 5,000 HP. or over, $10 per horse-power per year; 4,000 HP., $11, down to small powers of 300 HP., $21. It is now proposed, he says, to furnish Buffalo with power at about $18 per horse-power per year.

The question whether a factory had better be located at Scranton or at Niagara is not altogether one of the cost of electric, water or shaft power. For a paper mill, using great quantities of water, and in which the cost of power is perhaps the most important item of the total cost, Niagara may be the best location, but in most manufacturing establishments the question of heating in winter is an important one. In Scranton this can generally be done by the exhaust from the engine, while at Niagara coal would have to be transported for heating purposes. So also many factories use steam and heat for other purposes than merely furnishing power and warming the buildings, such as boiling, evaporating, drying, etc. For such factories cheap fuel is most important. On the whole, the writer considers that Scranton has the

advantage over Niagara in the matter of cheap power whenever heating of the buildings is an important item in the total cost of product, and he would not be surprised to see Scranton develop in the future in its manufacturing industries faster than the new towns about Niagara Falls, or than that part of Buffalo which may receive its power from Niagara.

CORRESPONDENCE SCHOOLS OF TECHNOLOGY.

A thorough technical education is now absolutely essential for a rapid and substantial advance in any of the many paths pointed out by the modern sciences. And this demand for technical training has called into existence a number of most excellent institutions in this country, elaborately and thoroughly equipped for instruction of this class. If the young aspirant for engineering honors, in any of its many branches, is in a position to avail himself of the exceptional opportunities for instruction provided by these technical schools, he should do so by all means. He will nowhere else find the same massing of organization, trained teachers, laboratory and workshop equipment and practical instruction.

But there are young men who cannot afford to quit work, or to leave home, to become resident students at one of these engineering schools, and who yet seek some practicable and efficient system of technical instruction. For the benefit of this latter and large class, schools have been lately established in the United States which instruct by correspondence; and the rapidity with which several of these schools have developed is proof sufficient that they were wanted.

"The Colliery Engineer," of Scranton, Pa., was the pioneer in this country in establishing, in 1891, a correspondence school for instruction in mining and the engineering trades. It commenced the school through the medium of its own columns, and was materially assisted in its work by the new mining laws of Pennsylvania, requiring more rigid examinations of foremen and others as to their theoretical and practical knowledge of mining affairs. Whatever the cause, the school thus founded grew rapidly, and it has now developed into the International Correspondence Schools, an incorporated body, with headquarters at Scranton, Pa., well organized and well equipped with a large staff of trained instructors. These schools now cover instruction in mechanics and the industrial sciences, including in these electrical and steam engineering, railway and bridge engineering, sanitary engineering, architecture, etc. Within the last two years a similar school has been independently started in Cleveland, O., by some well-known engineers, and it has progressed so far that it is incorporated as the Correspondence School of Technology, and is equipped with an able staff of teachers. The course of instruction is practically the same as that outlined below.

The scheme of instruction in these schools of correspondence may be briefly described as follows: As soon as the student is enrolled and a particular study is fixed upon, depending upon the previous knowledge of the student, he is provided with Instruction Papers Nos. 1 and 2, and Question Papers for the same; with these comes a circular-letter giving the student's class number and fully instructing him as to the method of proceeding in his studies. He is expected to first study all his instructions carefully and thoroughly, and the attempt is then made to answer the questions put to him on the paper provided. If he finds difficulty in understanding his subject and the questions proposed, he is provided by the school with addressed envelopes and information blanks, which latter he fills out and mails to the school. The instructor answers the questions thus put to him by return mail, and fully explains the difficulty encountered. When the student has answered all the questions on Paper No. 1, he sends it to the school, where it is examined, criticised and corrected and sent back with such suggestions and criticism indorsed upon it as will better enable the student to understand his subject. A percentage mark is given according to merit, and until 90% is reached the student must re-study and correct his work. When he gains a passing mark on one set of papers, another of higher grade is furnished him, and the same process is gone through with. These instruction and question papers are the only text-books used, and these, when properly filled out and corrected, become the property of the student, so that he can always refer to them. Diplomas and certificates of proficiency are issued to students completing all the subjects of the courses and who pass a final examination. These documents do not carry with them degrees, and the Principal of the school may demand that final examination be passed before a witness appointed by him if he thinks it necessary.

The cost of this system of instruction is small compared with resident attendance at a technical school. In the Scranton school eight scholarships are given, covering the following branches: Mechanical engineering and drawing, steam engineering, electric engineering, architecture, sanitary engineering, civil engineering, English branches and mining engineering. Each of these branches is subdivided under separate heads or courses. The cost of any one complete course in the eight named ranges from $35 to $50, excepting only civil engineering, which costs $150. Hydraulic, municipal, bridge and railway engineering and surveying are separate courses, ranging in cost from $25 for the last to $40 and $50 for any one of the others. As to the time required to complete a course, it is estimated that if a student can devote two hours per day for six days in the week to this work, it would take about one year to complete the electrical power and lighting course, or three years to finish the mechanical-electrical course.

COMPARATIVE TESTS OF STEAM-HEATING RADIATORS.

The multiplicity of existing forms of steam radiators naturally leads to questions regarding their comparative heating powers, and it was for the purpose of solving a few of these problems that the two sets of tests here to be described were undertaken. The object of the first series of experiments was simply the determination of the comparative steam-condensing powers of five types of radiators, selected from the general market. In the second series more elaborate experiments were undertaken. Four standard types of radiators were tested, one of these being also employed in the first series.

Tests for the City Hall, Richmond, Va.

In 1892 Mr. W. E. Cutshaw, M. Am. Soc. C. E., City Engineer of Richmond, Va., undertook to settle the question of the relative merits of five forms of radiators under consideration for use in heating the new City Hall, and conducted the first series of tests above referred to. In Table I. are given data in regard to the form and size of the radiators. The makers of the radiators, taking them in the order used in the table, are, respectively: Broomell, Schmidt & Co., York, Pa.; A. A. Griffing Iron Co., New York; Nason Mfg. Co., New York; Detroit Steam Radiator Co., Detroit, Mich.; Broomell, Schmidt & Co. It will be seen that two of the cross-sections are practically identical. Fig. 1 shows the arrangement of apparatus during the tests. The radiators were placed on five stands, S S, in the center of the room, 25 ins. above the floor, and were shielded from one another in all but tests No. 1 and No. 3, by the screens, P P. Steam entered the separator from the main, its pressure being throttled by the lower valve, V, and thence went to the radiators in an approximately dry condition. The water of condensation was caught and measured in a cylindrical iron trap at the end of each radiator.

Both radiation and convection tests were made. Test No. 1 was for radiation, and in it readings of steam pressure, temperatures of room and outside air, temperature over radiator and weight of steam condensed were taken every ten minutes for the space of one hour. Without changing the position of the radiators on the stands, test No. 2, a convection test, was performed. For this purpose each radiator was cased in a wooden box, with open slots back and front at the bottom, and having an opening 7 ins. square and a chimney 4 ins. high on the cover. In the chimney was placed an anemometer to measure the velocity of the heated air. Test No. 3 was for radiation, and was performed after the radiators had been shifted in position one point around the circle of stands. In this way radiation and convection tests were conducted alternately, a change of position occurring after every second test. The ten tests performed occupied portions of three successive days, and at the conclusion, each radiator had been tested twice in each of the five positions.

The averages of readings obtained in the five radiation tests are given in Table II, and of the convection tests in Table III. From these two

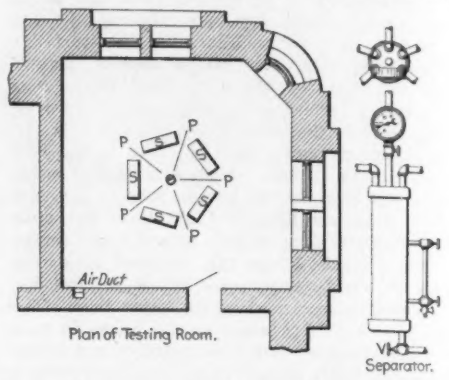


Fig. 1. Arrangement of Apparatus Used in Testing Steam-Heating Radiators at Stevens Institute of Technology.

have been compiled the summaries following Table III.

The temperature of the steam was not measured, but was taken as corresponding to the given steam pressure, dryness being assumed. The assumption was made also that 0.01536 B. T. U. is required to raise the temperature of 1 cu. ft. of air at 155° through 1°. The remainder of the results are obvious in their derivation. A comparison of these results shows the superiority, in both radiation and convection tests, of one of the simpler types of radiators.

Tests at the Stevens Institute.

The second series of tests was performed by Professors Jacobus and Denton, of the Stevens Institute of Technology, at the laboratory of that institution. On the title page of their printed report is placed the legend, "Extended Flue Radiation versus Plain Surface Radiation," and this indicates the object of the tests. By "extended surface" is meant the additional exterior surface gained by placing variously-shaped projections on the radiator loop, which are not in contact with

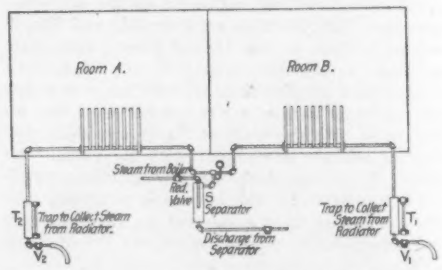


Fig. 2. Arrangement of Apparatus Used in Testing Steam-Heating Radiators for City Hall, Richmond, Va.

the steam, but are fed with heat by conduction through the intervening portions of the walls. In the Richmond tests only two of the radiators, A and D, had extended surfaces, while the cross-sections of the radiators tested at the Stevens Institute, shown in Table IV., are, with one exception, all of this type. Another point to be noted in connection with the form of the cross-sections is the fluelike action of the walls of radiators F, G and H. The neighboring loops are in close proximity, and between each two are formed air-spaces, or flues, from top to bottom of the radiators. It is thought by the makers that this arrangement, whereby strong convection currents are set up,

is beneficial to the action of the radiator. In Table IV. are also given the results of measurements of surface.

The object of this series of tests, as stated above, was attained in three distinct ways: (1) By the comparison of the heating power of extended surface radiators with that of duplicate radiators having the extended surface planed off, radiators F and H being used for this purpose; (2) by the comparison of extended surface radiators F, G and H with B, a plain surface radiator; (3) by testing single loops of the several radiators, in order to eliminate the flue action before mentioned. The arrangement of apparatus is shown in Fig. 2. The radiators to be compared were placed in two adjoining rooms, and connections to the steam supply made, as shown, through the separator S and reducing valve M. The condensed steam was led to traps T_1 and T_2, where it was measured. Both rooms had the same exposure to the influence of the outside atmosphere, there being a single window in each, which was kept open sufficiently to maintain the temperature nearly constant. Screens protected the radiators from a direct draft. Temperatures were measured by thermometers hung on each side of the radiators at a distance of 2 ft. and protected from the action of radiant heat by the intervention of a double screen of tin. All steam pipes and traps were thoroughly covered with non-conducting material, to reduce radiation therefrom.

Before starting a test, a preliminary run of about one-half hour was made to thoroughly heat the radiators. In starting the test the water was brought to a certain height in the traps T_1 and T_2. At 20-minute intervals the water was drawn off through the valves V_1 and V_2 and weighed. Each test was continued for an hour or longer, and at the end of that time the radiators were interchanged in position and the test repeated. A correction for the condensation in piping and traps was made in each test, and was determined by cutting out the radiators and noting the condensation during a short run. In most of the tests the radiator was placed in the center of the room; in several, however, it was placed near the side wall to obtain usual working conditions.

The data of all these tests and the results derived therefrom will be found combined in Table V.

From the above results Messrs. Denton and Jacobus draw the following conclusions:

1. The average heating capacity of radiator F, having about 57.8 sq. ft. total surface, of which about 41% is extended surface, is equivalent to the condensation of 0.0017 lb. of steam at about 3.9 lbs. pressure per sq. ft. per hour per degree difference of temperature between the steam and room. With the extended surface removed, the average condensation is 0.00204 lb. per sq. ft. per hour per degree difference of temperature. The average efficiency of the radiator without the extensions of surface is, therefore, 20% greater than its efficiency with the extension of surface.*

2. The average heating capacity of radiator H, having about 63.1 sq. ft. total surface, of which about 42% is extended surface, is equivalent to the condensation of 0.00145 lb. of steam per sq. ft. per hour per degree difference of temperature, while with the extended surface removed 0.00191 lb. is condensed. The efficiency without the extension of surface is, therefore, about 32% greated than its efficiency with the extensions.

3. The average heating capacity of radiator G, having about 61 sq. ft. total surface, of which about 10% is extended surface, is equivalent to the condensation of 0.00163 lb. of steam per sq. ft. per hour per degree difference of temperature.

4. The average heating capacity of the plain surface radiator B, having about 40 sq. ft. of surface, is equivalent to the condensation of 0.00243 lb. of steam per sq. ft. per hour per degree difference of temperature, so that its efficiency is 43% greater than that of the best, and 52% greater than the average of the extended surface radiators.

5. The results of the tests of the single loops show that in all of the radiators each loop acts with less than its maximum heating capacity, when coupled with adjacent loops, except in the case of the plain surface radiator B, in which the heating capacity of the complete radiator is practically equal to the sum of the maximum heating capacities of the separate loops.

6. So small a proportion of the total surface of radiator G is "extended" surface that it may be regarded as practically a plain surface "flue" radiator, whereas radiators F and H are "flue" radiators with a large proportion of extended surface. As, therefore, the efficiency of plain surface radiator B shows the same superiority over that of G as over that of F and H, it appears probable that the "flue" action reduces the efficiency. This conclusion is also supported by the

* (This should not be understood as meaning that the addition of extended surface produces no useful effect, but only that the extended surface itself is not as efficient as the plane surface. Adding 50% to the surface by means of the extensions may thus add not over 25% to the capacity of the radiator.—Ed.)

TABLE I.—Radiator Data.

	Our Own.	Bundy.	Nason.	Perfection.	B. S. & Co., pipe.
Symbol	A.	B.	C.	D.	E
Type	C. I.	C. I.	Pipe	C. I.	Pipe.
Sq. ft. heating surface.	40.72	46.77	45.25	44.44	47.28
Weight, lbs.	375.5	297.5	258.	342.5	269.
Wt. per sq. ft. htg. sur.	9.22	6.36	5.10	7.69	5.78

TABLE II.—Averages, Radiation Tests.

Test.	Steam press.	Temp. room.	Wt. of steam condensed per hour. A.	B.	C.	D.	E.
1	2.2	74.1	12.12	11.94	13.25	12.84	14.87
3	3.0	72.5	11.75	12.25	12.81	13.12	14.12
5	2.6	68.5	10.62	10.31	11.50	12.09	12.81
7	2.2	75.4	10.81	9.75	11.22	11.34	12.75
9	2.6	66.0	11.87	10.43	11.0	12.50	13.81
Average	2.52	71.3	11.43	10.93	11.95	12.38	13.65

TABLE III.—Averages, Convection Tests.

Test.	Steam press.	Temp. room.	Wt. of steam condensed per hour. A.	B.	C.	D.	E.
2	2.5	65.9	9.53	9.66	10.25	10.22	10.69
4	3.4	63.0	7.78	8.87	9.56	9.12	11.03
6	3.2	67.1	8.75	8.62	8.37	9.4	10.44
8	3.0	73.6	8.5	7.81	8.5	9.12	9.69
10	2.7	67.6	9.25	8.06	7.94	9.34	10.31
Average	2.56	67.4	8.76	8.6	8.92	9.44	10.44

Table IV.—Radiator Data.

Radiator.	Symbol.	No. of loops.	Surface in sq. ft. Total extended.	Total plain.	Total.
Joy, extended surface	F	9	23.817	34.0	57.82
" " " removed	F	9		40.41	40.41
Bundy, plain surface	B	14		40.25	40.25
Crescent, extended surface	G	9	6.004	54.81	60.82
Princess, " "	H	9	26.612	36.46	63.07
" " " removed	H	9		41.20	41.20

TABLE V.—Data and Computations.

No. of comparison.	No. of test.	Radiator.	Position of radiator in room.	Total of plain & ext'd surf., sq. ft.	Steam condensed, lbs. per hr., av., for two rooms.	Temp., av., of two rooms.	Steam press., lbs. per sq. in., av., of two rooms.	Steam condsd., lbs. per sq. ft. surf. per hr.	Stm. condsd. per deg. diff. temp. of rm. & stm., lbs. per hr. per sq. ft. surf.	Sq. ft. ext'd surf. equiv. to 1 sq. ft. plain surf.	% incr. condensation due to ext'd'g surf.	% incr. of surf. due to ext'd surf.
1	1	F, with ext'd surface	Center	57.81	16.63	49.4	3.85	0.28	0.0016			
	2	" without " "	"	40.41	14.44	50.7	3.87	0.35	0.0020	1.25	15.20	43.05
2	3	" with " "	"	57.81	16.84	49.6	3.94	0.29	0.0016			
	4	" without " "	"	40.41	14.05	49.9	3.93	0.34	0.0020	1.20	19.9	43.05
3	5	" with " "	"	57.81	17.41	50.6	4.02	0.30	0.0017			
	6	B	"	40.25	17.74	53.3	3.98	0.44	0.0025	1.49	.....	.....
4	7	F, with ext'd surface	3 ins. from partition	57.81	16.64	58.8	4.04	0.28	0.0017			
	8	B		40.25	16.14	59.1	4.05	0.40	0.0024	1.39	.....	.....
5	9	F	Center	40.41	11.40	70.0	3.90	0.28	0.0018			
	10	G, with ext'd surface	"	60.81	14.90	71.1	3.91	0.24	0.0015	1.15	.....	.....
6	11	" " " "	"	54.81	14.82	76.7	3.71	0.24	0.0016			
	12	B	"	40.25	15.14	78.4	3.59	0.37	0.0026	1.56	.....	.....
7	13	H, with ext'd surface	"	63.07	13.90	71.5	3.96	0.22	0.0014			
	14	" without " "	"	41.19	12.02	71.7	3.97	0.29	0.0019	1.32	15.7	53.09
8	15	B	3 ins. from side wall	40.25	12.97	72.9	3.77	0.32	0.0021			
	16	G, with ext'd surface		60.81	14.95	72.5	3.75	0.24	0.0016	1.31	.....	.....
Tests of single loops.	17	H, " " "	.....	7.18	2.16	70.5	4.1	0.30	0.0019			
	21	" without " "	.....	4.99	1.64	66.2	4.0	0.36	0.00231	1.19	31.4	59.6
	20	F, with " "	.....	6.39	2.12	67.6	4.0	0.33	0.0021			
	18	" without " "	.....	4.23	1.60	70.5	3.9	0.37	0.00247	1.17	32.3	50.9
	19	G, with " "	.....	6.23	2.24	68.8	4.0	0.36	0.00231			
	18	F, without " "	.....	4.23	1.60	70.5	3.9	0.37	0.00247	1.07		
	22	B, plain surface	.....	2.83	1.06	66.2	4.1	0.37	0.00237	.....	.....	.....

Summary, Radiation Tests.

	A.	B.	C.	D.	E.
Steam condensed, lbs. per hour, average	11.43	10.93	11.95	12.38	13.65
" pressure, average	2.50	2.50	2.50	2.50	2.50
Temperature of room, average	71.8	71.8	71.8	71.8	71.8
" " " steam, "	220	220	220	220	220
Steam condensed, lbs. per hour per sq. ft. of surface	0.279	0.233	0.264	0.278	0.288
" " " per degree diff. in temp. between room and steam, lbs. per hour per sq. ft. of surface	0.00188	0.00157	0.00178	0.00187	0.00194
Heat units given out per sq. ft. surface per hour	268	224	253	267	276
" " " " " " " " " " " per degree diff. in temperature between room and steam	1.80	1.51	1.70	1.80	1.86

Summary, Convection Tests.

	A.	B.	C.	D.	E.
Steam condensed, lbs. per hour, average	8.76	8.60	8.92	9.44	10.44
" pressure, average	2.96	2.96	2.96	2.96	2.96
Temperature of room, average	67.4	67.4	67.4	67.4	67.4
" " " steam, "	221.4	221.4	221.4	221.4	221.4
Steam condensed, lbs. per hour per sq. ft. of surface	0.215	0.183	0.197	0.212	0.220
" " " per degree diff. in temp. between room and steam, lbs. per hour per sq. ft. of surface	0.00139	0.00118	0.00128	0.00137	0.00142
Temperature of air in box, average	109.8	111.7	110.5	112.3	113.3
Air per hour, cu. ft.	5,890	5,804	5,562	5,940	6,396
Heat units given out per sq. ft. surface per hour	206	175	189	203	211
" " " " " " " " " " " per degree diff. in temperature between room and steam	1.84	1.69	1.70	1.86	1.95

fact that by the single loop results, the surface of radiator G, when not in contact with a confined mass of air, is equal in efficiency to the surface of radiator B.

IMPROVEMENT OF THE HARBOR OF CHARLESTON, S. C.

From a letter of Capt. Frederic V. Abbot, Corps of Engineers, U. S. A., and Engineer in charge, to the Charleston "News and Courier," we have the following account of the improvement made in the harbor and its entrance at Charleston, S. C.:

The entrance to Charleston harbor lies between Forts Sumter and Moultrie, and the harbor includes a harbor basin proper, about three miles long by two miles wide, and the two tidal basins of the Ashley and Cooper rivers, neither of which has any appreciable fresh-water discharge. In 1878, when the work of improvement commenced, the mean range of tide was 5.1 ft. and the quantity of water which entered and then left the harbor on each average tide was about 4,000,000,000 cu. ft. In storm tides a range of 11 ft. has been known, with a corresponding discharge of 12,000,000,000 cu. ft. in six or eight hours.

The general form of the tidal basin was such that the outward flow passed down a deep channel about one mile outside of Morris Island after impinging on Sullivan's Island, upon which was Fort Moultrie. In this channel depths of 35 ft. decreasing to 20 ft. were maintained for about three miles, and then decreased gradually until not more than 12 ft. could be carried out to sea at any point. The "Bar" outside of this deep channel was generally straight and parallel to the shore of Morris Island, and it connected with the shore of Folly Island on the south and Sullivan's Island on the north with gentle curves. The material on this bar was a fine sand, and, while shifting to a considerable extent, it was less easily moved than the loose sands on some of the Florida bars. While the main ebb tide moved over this channel route with maximum velocities of about 4 ft. per second, a large discharge was spilled over the bar, which was 10 miles long. The average depth on this bar ranged between 7 and 9 ft., with four channels across it containing from 10 to 12 ft. of water at low tide. The flood tide entered the funnel made by the shores quite uniformly over the bar, but it then piled and formed flood-tide channels in which the velocities were much greater than elsewhere.

The improvement now practically completed was devised by Gen. Q. A. Gillmore, and was based on the conditions stated. The jetties planned practically made a funnel, with the opening towards the land, and so arranged as to intercept the ebb tide passing between Forts Sumter and Moultrie, and to concentrate them on the bar at a single point. This point of the funnel was located near the northern end of the bar for two reasons: First, the general movement of the sand was from northeast to southwest, and there was thus less material to be washed into the channel by storms; second, the general flow of the ebb from the inner basin is about towards the point selected.

The order of work was largely controlled by the uncertainty of appropriations, which, for the first 13 years, averaged only about $170,000 per annum. At the end of August, 1894, the foundations of both jetties had been completed out to the crest of the bar. The funnel formed by the jetties has its origin upon Sullivan's and Morris islands, with a larger opening about 13,000 ft. wide. The jetties gently curve towards an apex opening 3,000 ft. wide at the crest of the bar, and to this crest the length of the north jetty is about 15,000 ft., measured on the curve, and the south jetty is about 18,000 ft. long to the same crest.

Work was commenced on the apex walls with mattresses and stone filling, and the wings were built later. The inner 6,000 ft. of both jetties are submerged, and do not practically interfere with the natural entrance of the flood tide by its original routes. The momentum of the ebb tide carries a great volume of water so far down into the funnel that it cannot flow off to the sides and must keep on through the apex. By Aug. 31, 1894, about 8,000 ft. of the north and 12,000 ft. of the south jetties had been raised to high tide or a little above. In July, 1895, the last stone was deposited, and the quantities used stood as follows:

	Stone.		Mattress.
	Tons.	Cu. yds.	Sq. yds.
North jetty	290,935	122,335	185,776
South jetty	480,641	143,414	329,870
Total	771,576	265,749	515,646

Up to Aug. 31, 1895, the dredging done has aggregated about 1,750,000 cu. yds., and further dredging will be needed for some time, until the channel has become adjusted to the new conditions.

The changes that have occurred from year to year since the work assumed any shape have been carefully watched and measured. The two shoals that originally lay between the jetty walls have been steadily pushed seaward; one has now passed out beyond the end of the jetties, and exists only as a rapidly-moving mass of sand with three 15-ft. channels through it at low water and with a very small area of less than 12 ft. of water. It is rapidly disappearing to the southwest. There is no evidence of any sand coming down the coast and piling up against either jetty. The survey of June, 1895, shows a good practicable 17-ft. channel from the sea to the city wharves. Over 16 ft. can be taken through on a single straight range. Of the three 15-ft. openings through the outer bar one is too narrow for use, but the two others are 300 ft. and 900 ft. wide, respectively. A number of vessels drawing over 20 ft. have passed in within the year, and one drawing 22 ft. 3 ins. came safely into the inner harbor.

During the last fiscal year 1,063,505 cu. yds. of material have disappeared from the area bounded by the parallel walls of the jetties and a continuation of these lines 1,500 yds. seaward and 1,800 yds. landward. Of this aggregate 592,562 cu. yds. were removed by dredging and 470,943 cu. yds. by the natural scour. This gain in waterway equals the whole amount gained from 1884 to 1893. The original project calls for a 21-ft. low-water channel across the bar, and the estimated cost was $3,000,000. About $2,500,000 has been expended.

A 94-IN. SEWER AND STORM OVERFLOW AT DENVER, COLO.

Aside from the storm overflow illustrated herewith, the chief interest in this sewer work lies in the fact that it was done by the day, instead of under contract. This feature will therefore be taken up first, and may be best introduced by the following letter, slightly abridged from the original, addressed to this journal on March 7, 1895, by Mr. Edmund P. Martin, Chief Engineer of the Denver Department of Public Works:

I send you herewith a copy of a report on the cost of the 94-in. section of the Delgany St. sewer extension in this city, which you will find of interest to the general reader, mainly for the reason that it affords a concise and detailed statement of the cost of municipal improvements on a large scale by the day-labor plan. Under the present charter of Denver it is not possible to do public work by any but the contract method, with the exception that improvements of a broadly public nature, as distinguished from local or district improvements, can be built by day's labor at the option of the Board.

Under this provision the present Board of Public Works organized to construct the Delgany St. public sewer extension, and as having a direct bearing upon the subject and showing the strong effort that was necessary to divorce the work from politics, I will here quote from my letter of May 29, 1894, to the Board, upon the subject of organizing for this construction:

> All men, including the engineer corps, should be made to understand at the outset that the authority of the Engineer-Superintendent of construction is absolute, even to the power of dismissal; that the Chief Engineer, and finally the Board of Public Works, will sustain him in any and all of his acts as regards discipline. Should it occur that he exceeds his authority, the remedy of the Board is in his own dismissal, and not in reversing any of his erroneous decisions publicly in the presence of his subordinates.
>
> I do not wish to be regarded as volunteering advice, but wish it understood from the first what my position is in regard to a matter upon which, in my opinion, much depends for the ultimate success of an enterprise which to this locality is novel.

To the honor of the present Board I will say that they followed the advice given in the above quotation, even in the face of opposition from the state's executive, who, if I am correctly informed, could not see why persons of one particular political faith should not receive the preference. There was no end of opposition, as above stated, from politicians and a few of the contracting fraternity. Every possible obstruction was interposed to defeat the purpose of the Board; it was almost positively asserted on all sides from the classes named, that to proceed upon this plan would end in ignominious failure. Threats and legal injunctions were resorted to, and I believe no possible expedient that promised to delay or stop the work was left untried; but the Board persevered and fought its way to the front inch by inch, until finally all obstructions were overcome and construction was commenced and proceeded with.

Engineers were for the most part found to be in favor of the new departure, and a few were bold enough to publicly so express themselves, even in the face of the prevailing strong, local, popular prejudice.

I also send you a blueprint copy of the form of statement upon which we preserve the record of these operations, and the sheet I send you shows the total cost in detail of the three-ring standard section of 94-in. sewer built in a masonry cradle.

Likewise I send you a sheet showing sections of the Delgany sewer extension, and plans with sections (see accompanying illustrations), of the storm overflow spillway, designed by me, to discharge directly into the river at 31st St., all above an amount equivalent to the calculated maximum sanitary flow of the city past this point. At this place the sewer crossing the low lands approaches within a few feet of the river channel, and affords the first convenient opportunity to dispose of the surcharge from storms, and below this point we consequently need to provide for nothing more than the estimated sanitary sewage flow, inasmuch as the topography of that portion of the city tributary to all points below this is such as to permit the discharge directly into the river over the Delgany main for all storm sewers that may in future be constructed.

The report of the Assistant Engineer embraces a comparative statement showing what is believed to be an absolutely just and equitable comparison between the cost of the old 92-in., three-ring Delgany main, as constructed by contract, and the cost of the lately constructed 94-in., three-ring main constructed by day labor. The effort is made to adjust all differences in prevailing prices of material and labor, so as to make the comparison absolutely impartial.

The most interesting points in the report of the Assistant Engineer, Mr. W. W. Follett, M. Am. Soc. C. E., in charge of construction, were as follows:

The length of the section under consideration, which is about one-fourth of the work undertaken, is 2,394 ft. The cost of the standard section (A B, on the accompanying illustration), including engineering, inspection and supervision, averaged $20.58 per lin. ft. Some extras were incurred, which are not included in this amount.

About three years ago the city built a main sewer, the last 1,719 ft. of which was 92 ins. in diameter, or 2 ins. less than the work just completed. The contractors for the old work were Murphy & Nellis, of Omaha, and their contract price averaged $24.95 per lin. ft., to which must be added $1.28 for supervision by the city, making the cost of the 92-in. sewer $26.23. Mr. Follett estimates that a 94-in. sewer would have cost 59 cts. per ft. more, which would make the cost of contract work, on the basis of the prices of three years past, $26.82, against $20.57 for the work completed by day's labor early in 1895. In justice to both classes of work, Mr. Follett wishes to add to or deduct from the above difference against contract work some allowances for the difference in prices actually paid by the Board and the contractors for material and labor. He assumes that all the natural conditions and those imposed by the city under which the two pieces of work were done were so nearly alike that they need not be taken into account. He summarizes the cost of the work under various items, ascertains the percentage of each item to the total, and then multiplies each of these percentages by the difference in prices per unit paid by the contractors and the Board, assuming the latter as 100. Thus, brick masonwork amounted to 2.326% of the total cost of the work done by the city, and for this the city paid $4 and the contractor $7 a day, or 75% more; $2.32 \times 75 = 1.745$, which percentage, under this plan, must be added to the cost of contract over city work.

For the whole work "certain items," to quote from the report, "at the contractors' prices would have added to the Board's actual cost 5.592%, and certain other items would have subtracted therefrom 8.737%, thus giving a net deduction from the

Board's cost of 2.145% on the basis of Murphy & Nellis's prices and material used, or an addition to theirs of 2.145% on the basis of the Board's prices and materials used." Mr. Follett assumes the latter basis, and adds 2.145% of $26.82, the cost per foot of a 94-in. sewer under contract, to this cost, or 58 cts., thus making out that had the work been done by contract instead of by the city, it would have cost $27.40 against $20.57 actually paid, or $6.83 more. Manifestly the 58 cts. should have been subtracted instead of added, as it is absurd to maintain that for purposes of comparison it must be assumed that the contractors pay as high prices for material and labor as the city. Deducting this sum, the saving becomes $6.25 per lin. ft. in favor of the city work.

Mr. Follett claims that the sewer built by day's labor was better built than that built by contract, and that the saving in cost was "not due to close bargains driven with those supplying material nor to low wages paid labor," and then adds, "the wages paid for common labor were about 40% higher than the ruling prices in the market." But, as already shown, according to his figures the difference in prices for material and labor under the two plans was only 2.145%.

As to what the work could have been done for by contract, Mr. Follett says:

It does not follow from the fact that the cost on the basis of Murphy & Nellis's contract would have been $27.40 that the Board could not have let the work for less than that. Contractors were mighty hungry last summer (1894), and would probably have bidden very close on this work if it had been advertised, but they would have had to make some profit, and they would have made it by paying wages far below those paid by the Board, by screwing down the material men and scamping the work.

An important point bearing on the cost of the contract work on the 92-in. sewer is stated by Mr. Follett at the close of his discussion. The contractors have unsettled claims for extras, amounting to about 30% of their contract. If only one-half of these claims are allowed, and assuming that they are distributed equally over their whole contract, including the 92-in. sewer, the cost of the latter would be increased by 15%.

Mr. Follett gives figures of detailed cost of the 94-in. sewer built by day's labor, some of which are as follows:

Concrete.—946.6 cu. yds. were laid, at an average cost of $4.87 a yard, distributed as follows: Cement, 0.756 bbls., $2.61; broken stone, 0.777 cu. yds., $1.40; sand, 0.47 cu. yds., 16½ cts.; water, 1 ct.; labor, 68½ cts.

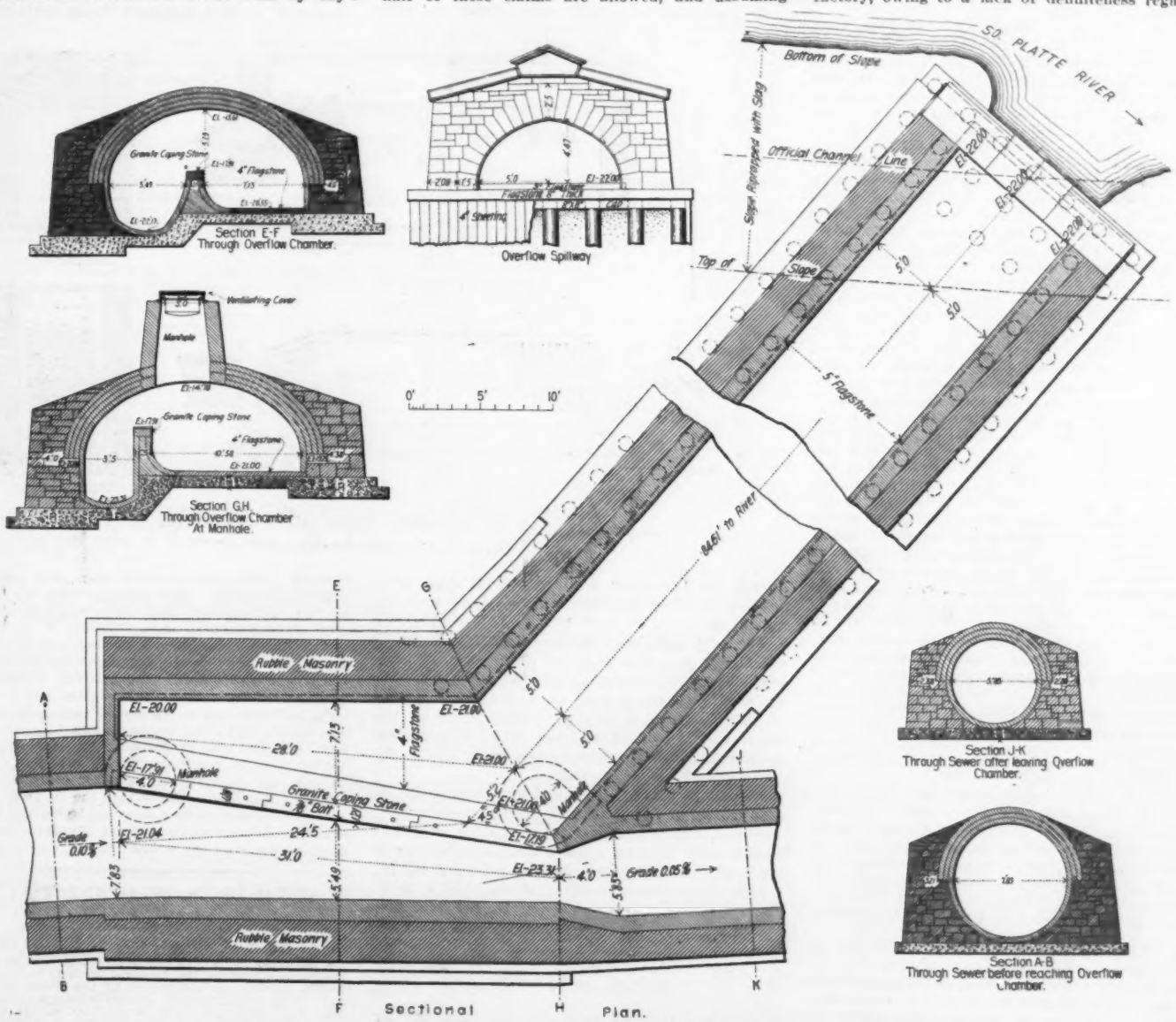
Rubble masonry.—4,295 cu. yds. were laid at an average cost of $4.72 a yard, distributed as follows: Rock, 1.3 tons, $1.965; cement, 0.848 bbl., $1.175; sand, 0.292 cu. yd., 11½ cts.; water, ½ ct.; labor, $1.46.

Brickwork.—1,800 cu. yds. were laid at an average cost of $8.56½, distributed as follows: Brick, 438.3, $4.07; cement, 0.835 bbl., $2.01; sand, 0.34 cu. yd., 15 cts.; manhole covers, slants, water, 8½ cts.; centers and lagging, 22½ cts.; labor, $2.025.

All the above are exclusive of tools, pumping and supervision.

The purpose of the storm overflow shown in the accompanying plan and sections is explained near the end of Mr. Martin's letter, quoted at the beginning of this article. The illustrations need no further explanation.

The Board of Public Works of Denver is composed of Mr. Arthur C. Harris, President, and Messrs. Thos. B. Buchanan and Clarence W. Rhodes. Mr. W. F. Hynes is Secretary of the Board and Mr. Edmund P. Martin is Engineer, as already stated. We are indebted to Mr. Martin for the drawings and other information from which this article has been prepared.



PLAN AND SECTIONS OF DELGANY ST SEWER AND STORM OVERFLOW; DENVER, COLO.

causes for the lesser cost of city work; but if he has rightly eliminated the variations in prices for labor and material, it must follow that the contractor got less work out of his men, and used or wasted more material, provided natural conditions, as is assumed by Mr. Follett, were the same in each case. No figures are given in relation to the rate of progress under the two plans.

THE DUTIES AND POWERS OF THE CITY ENGINEER OF WOONSOCKET, R. I.

The status of many city engineers is very unsatisfactory, owing to a lack of definiteness regarding their duties and powers or to the fact that these are extremely limited. Such conditions make this important official too often subject to the caprices or whims of city councils or higher other officials.

The city council of Woonsocket, R. I., has recently passed an ordinance, which has since been approved, entitled "An Ordinance in Relation to the City Engineer." The ordinance puts upon this officer the whole engineering work of the city, without regard to its character, and specifically states that he shall be consulted on all important matters where the advice of an engineer would be of value. The ordinance seems to have the merit of being neither too general nor too specific. In other words, it is not vague in its provisions, so as to give rise to frequent misunderstandings, and it is not so specific, except in a broad way, as to be inflexible. Sensible men, conducting municipal af-

fairs on a business basis, ought to be able to work admirably under its provisions, while men of another case might be checked at some points if restraint were necessary. The ordinance in full is as follows:

Sec. 1. The city engineer shall perform all such services for the city of Woonsocket as properly come under the direction of a civil engineer or surveyor, and shall be consulted upon all important matters relating to public improvements of every kind where the advice of an engineer or surveyor would be of service.

Sec. 2. Said engineer, when required by the city council or either branch thereof, or any committee or commission appointed by said council, shall, under their direction, establish the lines and grades and prepare all plans and specifications for public work, and shall prepare, or cause to be prepared, by the city solicitor, all contracts for the same.

Sec. 3. Said engineer shall prepare all plans, statements, and estimates, and furnish all information required in relation to the grading, laying out, enlarging, straightening or otherwise altering streets. He shall prepare all plans required by the city solicitor for use at all trials or hearings in which the city has an interest. He shall inspect all work being done for the city, either by contract or otherwise, in which the services of an engineer or surveyor may be required, and report all defects to the department, commission or committee under whose supervision the work is being done. He shall measure, or cause to be measured, all work done by contract for the city, and shall certify to the same. He shall cause suitable signs, with names of streets, to be put up at all street corners in the city, and also suitable numbers be attached to all buildings and dwelling houses in the compact part of the city, and shall keep a record thereof. He shall make such surveys and plans as may be required by the board of assessors of taxes. He shall be the custodian of all plans relative to all work under his charge, and shall keep the same properly classified and indexed. He shall keep a record, systematically arranged, of all highways in the city. He shall give to all applicants, so far as the files and records of his office will permit, any information they may require as to the lines and grades of streets, location of street numbers, etc., etc.

Sec. 4. Said engineer shall make annually, or oftener if required by the sub-committee on bridges of the board of aldermen, a careful examination of all bridges in the city, and make report to said sub-committee respecting their condition, with such recommendations as to their repair or removal as the exigency of the case and the safety of the public may require, and shall each year, on the first Monday in January, present to the city council an estimate of the probable cost of repairs upon each of said bridges for the ensuing year.

Sec. 5. Said engineer shall annually, on the first Monday in January, present to the city council, a printed or written report in relation to his department, showing the number of persons employed, the detailed expenses of the department, the nature of the works which have been completed during the year, and such other general information and suggestions in relation to the same as he may deem expedient.

Sec. 6. Said engineer shall receive such compensation as the city council may from time to time determine.

He may, from time to time, with the consent of the finance committee of the city council, employ such assistance in his official duties as the exigencies of the city and the needs of his department may require, and he shall fix, with the consent of aforesaid committee, their compensation. He may discharge any assistant employed in his department.

Sec. 7. Said engineer shall prepare all plans for the construction of streets, sewers, and water-works, and perform all such duties in reference to the construction, reparation, or maintenance of the streets, sewers, and water-works of the city, as the city council, sewer or water commissioners may require, and shall make such estimates and furnish such information in relation to the streets, extension of the sewerage system and water-works as may be required of him by the city council, sewer or water commissioners.

A CATCHBASIN FOR LARGE FLOW; PEORIA, ILL.

By W. C. Parmley.*

Among the many designs of storm-water inlets in use, the one shown in the accompanying illustration will probably interest engineers who have had occasion to study this subject. It was designed in 1893 to be used at points where water passes the common catchbasin, or where the volume of flow is unusually large.

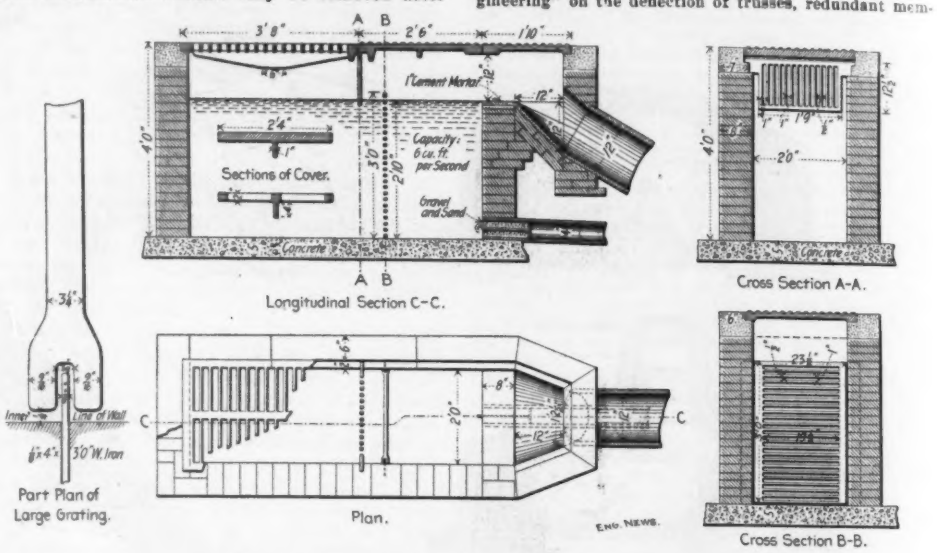
The inlet consists of a rectangular pit 2 × 6 ft. in size, with concrete bottom, brick walls and cut-stone coping, covered partially by a cast iron grating and partially by perforated cast iron covers, as shown. The inlet is set in the gutter with the top of the plates depressed about 2 ins. below the surface grade line. The water falls through the cover grate, and thence passes the two inner grates, shown in sections B B and C C.

Most of the rubbish is thus removed, and the water discharged over the sill to a 12-in. outlet pipe. The water remaining in the catchbasin after the storm is over is drained off by a 4-in. tile connecting with the discharge pipe. This tile is partially choked by a gravel filter held in place by a perforated iron plate attached to a hook-shaped iron handle. The filter can thus be easily removed and replaced whenever necessary.

The accumulated rubbish may be removed after lifting the two inner gratings out of place, thus leaving a pit of convenient shape to be shoveled out.

The inlet capacity is estimated at from 12 to 15 cu. ft. per sec., with 2 ins. of water over the grating, and the outlet capacity is estimated at 6 cu. ft., or about six times that of the ordinary catchbasin. On steep grades the coping stone at the upper end is omitted and the adjacent pavement depressed, leaving a clear passageway under the upper end of the cover grating.

About a dozen of these catchbasins were built the past season, and they have proved very satisfactory. The cost, including sewer connection, is from $55 to $65 each. In some cases a smaller sized inlet is used, which differs only in having a pit, 2 × 4½ ft., a depth over discharge sill of 10 ins., and a 10-in. outlet pipe, giving about 4 cu. ft. per sec. discharge capacity. The cost is thus reduced about $5.



DETAILS OF STANDARD CATCH BASIN PEORIA, ILL.
Designed by Walter C. Parmley, C. E.

BOOK REVIEWS.

HOPKINS' RAILWAY LIBRARY, Catalogue of. By Frederick I. Teggart, B. A., Assistant Librarian, Leland Stanford Junior University, California, 1895. Quarto; pp. 231; $1.50 bound; $1.25 unbound.

The nucleus of this library, some 2,000 volumes and pamphlets, was presented to the University, in 1892, by Mr. Timothy Hopkins, of San Francisco, and has since been materially added to by purchase. The books and pamphlets are classified under appropriate subject heads and subdivided geographically, with a short note appended to the title in each case, giving some idea of the contents. It is chiefly interesting as being one of the fullest library catalogues in the United States of works relating to railway construction, equipment, operation, economics and law.

PROBLEMS IN THE USE AND ADJUSTMENT OF ENGINEERING INSTRUMENTS. Forms for field-notes, general instructions for extended students' surveys. By Walter Loring Webb, C. E., Assoc. M. Am. Soc. C. E., Assistant Professor of Civil Engineering in the University of Pennsylvania. New York: John Wiley & Sons. 16mo; pocketbook form; pp. 64; $1.

The problems commence with the simplest linear measurements with chain and steel tape, and include the setting out of angles by the chain, and their test for general accuracy of "closure." Then follow compass practice, leveling and transit work, with practice for testing adjustments, and practical problems in each case, samples of field-notes, etc. Work with the plane-table, sextant, barometer, stadia, etc., is followed by the simpler problems in railway surveying. The work is intended for beginners, and covers the first elements of instrumental practice, a field generally neglected in text-books and note-books for engineers; or, at most, very lightly touched upon. Its use should materially assist, not only the student in engineering, but also his teacher and the engineer in the field, who has "a green corps" upon his hands to instruct.

STATICALLY INDETERMINATE STRUCTURES and the Principle of Least Work. By Harold Medway Martin, Wh. Sc. Revised and Reprinted from "Engineering." London: Offices of "Engineering." 12mo; cloth; pp. 71; 26 figs. in the text.

This little volume is a reprint of articles from "Engineering" on the deflection of trusses, redundant members in double systems, solid floors, and arched and suspension trusses. The principle that the work of the internal streesses must be a minimum consistent with other conditions of equilibrium, is an important and useful one, which has been developed in this country by Professors Swain and Cain, and in Europe by Castigliano and others. The principle is now recognized as a fundamental one in statics, and as particularly useful in the discussion of cases which are indeterminate under the common rules. In our issue of Sept. 5, 1895, will be found an article by Professor Merriman on its application to the deduction of formulas for the reactions of partially continuous drawbridges. Mr. Martin shows that the theorem of three moments for continuous girders can be derived from the principle of least work, and his discussion of trough floors for bridges is an interesting and timely one.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Right of Action Against Contractor.

A provision of a city charter that no action shall be maintained against the city for injuries caused by defective streets, unless notice of the claim shall have been given to the city in writing within a certain time, does not affect the right to sue the person by whose act the street was rendered defective.—Rider v. City of Mount Vernon (Supr. Ct., Gen. Term, 2d Dept.). 33 N. Y. S. Rep., 745.

Evidence of Boundary.

The owners of city lots had for 35 years maintained a fence between their lots and the street, and the city acquiesced therein. The marks of the original survey having been destroyed, a resurvey was made on the theory that the original survey was wrong and should be corrected. It was held that the fence was better evidence than the resurvey as to the location of the line between the lots and the street.—City of Mt. Carmel v. McClintock (Supr. Ct. of Ill.), 40 N. E. Rep., 829.

Duty to Repair Lateral Service Pipes.

A city established a system of water-works which did not include lateral service pipes. These and the expenses of putting them in were to be paid for by the one who connected with the water main in the street. The Supreme Court of North Dakota held that such lateral pipe was owned and must be kept in repair by the one who made the connection, and not by the city, and that the city was justified in severing such connection where the owner refused to pay the expenses of repairing a break in such lateral service pipe in the street a short distance from the main pipe, although he had paid his water rates for a period running beyond the time when said connection was served.—Jackson v. Mayor of Ellendale, 61 N. W. Rep., 1059.

* First Assistant City Engineer at the time this article was prepared, in March, 1895.

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PERSONALS.

(Readers are requested to contribute items of interest for publication in this column.)

Mr. A. Howell Napier, civil engineer, of New York city, died Dec. 23.

Mr. John Rogers, contractor and builder, of Toronto, Ont., died Dec. 11.

Mr. J. W. Luke, Chairman of the Iowa State Railroad Commission, died at Hampton, Ia., last week.

Mr. David M. Thorburn, of Duluth, Minn., head of the contracting firm of Thorburn & Co., died Dec. 20.

Mr. E. B. Baker, City Engineer of Gloversville, N. Y., has resigned in order to accept a position with the Central Engineering Co., of Illinois.

Mr. F. G. Darlington will resign his position as Superintendent of the Indianapolis Division of the Pennsylvania Railroad, on account of ill health.

Mr. John O'Neill, civil engineer and surveyor, of Ballinger, Tex., died Dec. 15. He was one of the engineers on the construction of the Union Pacific Ry.

Mr. P. Campbell, General Manager of the Birmingham, Sheffield & Tennessee River Ry., has resigned, and will remove from Sheffield, Ala., to New York city.

Mr. Henry Franke, Treasurer of the Phœnix Iron Works, Brooklyn, N. Y., died Dec. 20, at the age of 55. He was born in Germany, and came to this country 28 years ago.

Mr. Wm. Apps, Master of Car Works, Illinois Central R. R., has accepted the position of Master Car Builder of the Canadian Pacific Ry., succeeding Mr. Higginson.

Mr. W. S. Bacot, M. Am. Soc. C. E., gave a lecture on "Road Construction" at the meeting of the East Orange Township Improvement Association, East Orange, N. J., Dec. 14.

Col. Henry M. Robert, Engineer Corps, U. S. A., now engineer of the Southwest Division, has been transferred to Detroit, Mich., as engineer of the Northwest Division.

Mr. Charles F. Mayer, President of the Baltimore & Ohio R. R., tendered his resignation at a meeting of the directors on Dec. 18, but will retain his position until a successor is appointed.

Mr. E. F. Tabor has been appointed engineer in charge of the construction of a system of water supply for San Jacinto, Cal. He was formerly engineer of the Escondido irrigation system.

Mr. W. A. Jones, an engineer engaged on the government works near Tuskaloosa, Ala., committed suicide recently by jumping from a train near Tyler, Tex. He is thought to have been insane.

Mr. I. P. Keeler, Manager of the Raleigh Electric Co., of Raleigh, N. C., has resigned to go to Philadelphia. Mr. Charles Johnston succeeds him as manager of the street railway and lighting plants.

Mr. Benjamin H. Hall, of the firm of Hall Bros., civil and mining engineers, 415 Temple Court, Atlanta, Ga., has been appointed engineer in charge of the Georgia hydrographic work for the United States Geological Survey.

Mr. T. D. W. Cuyler has been elected President of the new company formed by a consolidation of the Keokuk & Western and Des Moines & Kansas City railways, the latter of which has at present a gage of 3 ft. Mr. A. C. Goodrich is General Manager, and Mr. J. P. Boyle General Superintendent.

Mr. W. C. Brown, General Manager of the Hannibal & St. Joseph and associated lines of the Chicago, Burlington & Quincy R. R. system, has been appointed General Manager of the C. B. & Q. system, succeeding Mr. W. F. Merrill, now Vice-President of the Erie R. R. Mr. Howard Elliott will succeed Mr. Brown.

Mr. James B. Seager, M. E., has been appointed general manager of the Mackolite Fireproofing Co., of Chicago Heights, Ill. He was until recently general manager of the Excelsior Red Stone Co., and was formerly a consulting civil and mining engineer, with headquarters at Hancock, Mich.

Charles B. Brush & Co. will, on and after Jan. 1, carry on the civil engineering business heretofore conducted by Mr. Chas. B. Brush, with principal offices at No. 1 Newark St., Hoboken, N. J. The new firm will consist of Mr. Chas. B. Brush, M. Am., Soc. C. E., and Mr. Walter F. Whittemore, Asso. M. Am. Soc. C. E. The latter has been for many years chief assistant to Mr. Brush. The specialties will continue to be hydraulic and sanitary engineering surveys, borings, fire insurance maps, and city and harbor improvements.

Mr. John Russell Hind, the English astronomer, died Dec. 23 at Twickenham, England. He was born in 1823, and in 1843 was appointed an assistant in the Magnetical and Meteorological Department of the Royal Observatory, at Greenwich, under Prof. Wheatstone and Mr. Airy, the Astronomer Royal. He discovered several new planets and was the author of several works on astronomy. He was President of the Royal Astronomical Society in 1880, and was for a long time Superintendent of the Nautical Almanac Office.

Mr. Charles B. Atwood, a noted architect, of Chicago, Ill., died Dec. 19. He was associated with Mr. D. H. Burnham in the architectural work of the Columbian Exposition, and designed the Peristyle and the Art Building, the latter being a permanent structure, which is now used as a museum. He was born in Charlestown, Mass., in 1849, and at the age of 17 became a pupil of Ware & Van Brunt, architects, of Boston. He designed the Vanderbilt residences in New York city, as well a number of other private and public buildings.

Mr. L. M. Wright, who died at Troy, N. Y., Dec. 15, was born in St. Johnsbury, Vt., 86 years ago. His first important work as an engineer was at Lawrence, Mass., when the town was founded. With Captain Bigelow he was engaged in improving the water power of the place under the direction of the Essex company, and also superintended the construction of some of the mills there. He devised the plan for improving the water power at Hadley Falls, organized a company and sank all his money in the enterprise, but the plans have since been successfully carried out. During the war he enlisted in a New York regiment and served with the engineer corps.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 2. Secy., C. H. McLeod, Montreal.
ENGINEERS' CLUB OF COLUMBUS, O.
Jan. 4. Secy., David Buel.
ENGINEERS' CLUB OF PHILADELPHIA.
Jan. 4. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERING ASSOCIATION OF THE SOUTH.
Jan. 9. Secy., Lucius P. Brown, Nashville, Tenn.
INDIANAPOLIS ENGINEERING CLUB.
Dec. 28. Sec., C. C. Brown.
WESTERN SOCIETY OF ENGINEERS.
Jan. 1. Secy., Chas. J. Roney, Monadnock Block, Chicago.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Jan. 3. Secy., O. H. Von Geldern, 819 Market St., San Francisco.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Jan. 6. Secy., G. L. Annan, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
Jan. 6. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
MICHIGAN ENGINEERING SOCIETY.
Jan. 6, 7, 8. Annual meeting at Saginaw, Secy., F. Hodgman, Climax, Mich.
INDIANA ENGINEERING SOCIETY.
Jan. 7, 8, 9. Annual meeting at Indianapolis. Sec., J. F. O'Brien, Cloverdale, Ind.
COLUMBIAN ENGINEERING SOCIETY.
Jan. 7. Secy., W. F. Hart, University Bldg., 15th and H Sts., N. W., Washington, D. C.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Jan. 8. "Cost of Sewer Construction at Denver, Colo.," by W. W. Follet. Sec., C. W. Hunt, 127 E. 23d St., New York.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
Jan. 9. Sec., Jas. K. Zollinger, Norton Building.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Jan. 11. Secy., Forrest J. Smith, Denver Block, Helena.
CENTRAL RAILWAY CLUB.
Jan. 10. Secy., H. D. Vought, "Courier" Office, Buffalo, N. Y.
ENGINEERS' CLUB OF KANSAS CITY.
Jan. 13. Secy., F. W. Tuttle, Baird Building.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Dec. 18, Mr. E. P. North in the chair, Dr. Thos. Egleston made a brief statement as to the progress made towards the adoption of an international standard metric system of gages and measurements, and as to the present status of the movement in several countries. The matter has already been clearly presented in our issue of Aug. 1, 1895.

An interesting review of the history and uses of asphalt was then read by Mr. Rudolph Hering, and followed by views of asphalt-lined reservoirs. He called attention to the necessity of a priming coat of asphalt and gasoline to insure a firm adherence of the lining to the slope walls. Mr. John C. Trautwine then described the defective Queen Lane reservoir at Philadelphia, and showed a number of views illustrating the character of the failures and the methods taken to effect repairs and make the reservoir water tight. The official report on this work was published in our issue of August 15.

NEW YORK RAILROAD CLUB.—At the meeting on Dec. 19, Mr. G. W. West, President, in the chair, Mr. Snow, of the Executive Committee, announced that Mr. W. G. Wattson had been elected Secretary of the club, in place of Mr. John W. Hill, who has resigned after four years service. Mr. L. R. Pomeroy read a short paper on "Balanced Slide Valves," describing various forms of such valves, and pointing out their many advantages. In the discussion it was shown that balancing was necessary for the large and heavy valves now used on modern engines, and that its adoption effects an important reduction in friction and wear of the valves and valve gear, and enables the engineman to handle the engines to better advantage. One particular case was mentioned in which steam had to be shut off before the engineman could handle his reverse lever.

A topical discussion on "The Causes of Train Detentions," was then opened by Mr. Mendenhall. In regard to the detention of passenger trains, he attributed 89.3% to arbitrary traffic and operating causes, and 10.7% to equipment, the latter being again subdivided into 55% for locomotives and 45% for cars. The distribution under these heads was as follows:

Locomotives.		Cars.	
Hot journals	33%	Hot journals	48%
" eccentrics	3"	Brakes	38"
Steam failures	24"	Steam heat	4"
Brake "	13"	Parting	5"
Tak'g water (tr'k tanks)	5"	Miscellaneous	5"
Couplers, injectors, steam heat and miscellaneous	5"		

This paper brought out an interesting discussion on (1) systems of inspection to prevent detentions through failures of machinery; (2) systems of discipline to prevent detentions due to waiting for passengers, baggage or express matter; and (3) systems of reports to enable detentions to be traced to their actual causes.

ENGINEERING ASSOCIATION OF THE SOUTH.—The December meeting was held at Atlanta, Ga., in the South Carolina Hall of the Woman's Building, at the Cotton States and International Exhibition. A paper was read by Mr. B. M. Hall on "Gold Mining in Georgia," and Mr. Grant Wilkins described the engineering features of the exhibition.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Dec. 18, the result of the election of officers for 1896 was announced as follows: President, J. A. Ockerson; Vice-President, Edward Flad; Secretary, William H. Bryan; Treasurer, Thomas B. McMath; Director, M. L. Holman; Librarian, W. A. Layman; Members of the Board of Managers of the Association of Engineering Societies, J. B. Johnson and W. E. Barns. The retiring president, Mr. Russell, resigned the chair in favor of the incoming president, Mr. J. A. Ockerson, and then gave an address on "The Work of Engineers' Clubs." Other addresses were afterwards made as follows: "Engineers' Clubs, Their Best Fields of Usefulness," Robert Moore; "The Engineer at Home and Abroad," Julius Pitzman; "The Engineer of the Future," Richard McCulloch; "The Association of Engineering Societies," J. B. Johnson; "The Engineers' Club of St. Louis," C. M. Woodward; "The Standing and Character of the Engineer," George H. Reynolds.

William H. Bryan, Sec'y.

NEW PUBLICATIONS.

SEVENTH ANNUAL STATISTICAL REPORT OF THE INTERSTATE COMMERCE COMMISSION. On the Statistics of Railways in the United States for the Year Ending June 30, 1894. Prepared by the Statistician to the Commission. Washington: Government Printing Office. 8vo; pp. 676; with maps and diagrams.

This work was fully reviewed in our issue of Oct. 31, from the advance sheets.

CALIFORNIA MINING STATISTICS.—The California State Mining Bureau has recently issued Bulletin No. 7, a single sheet of the inconvenient dimensions of 24 × 36 ins., showing by counties the mineral production of the state for the year 1894. The principal products, with their values, are: Gold, $13,923,281; silver, $297,331; quicksilver, $934,000; miscellaneous metals, antimony, lead, copper, iron, manganese and platinum,

$114,598; non-metallic substances: borax, $807,807; coal, $139,862; mineral waters, $184,481; salt, $140,087; asphaltum, and bituminous rock, $348,993; petroleum, $1,064,521; natural gas, $79,072; structural materials, including stone, cement, brick, etc., $2,056,026.

TABLE OF AREAS OF TRAPEZOIDS. Made by P. H. Ashmead, C. E. Distance between parallel sides, from ⅛ to 79 ft., inclusive. Sum of parallel sides, from 0.1 to 80 ft., inclusive. Submitted by E. R. Shnable, Assistant Engineer. Approved by Isham Randolph, Chief Engineer Sanitary District of Chicago. 12mo; 16 blueprint tables; copyrighted by the Sanitary District of Chicago.

This is a companion series of tables to the tables of cubic contents lately noticed in these columns. The area sought is found directly in the tables, for the whole sum of the parallel sides and under the proper column head for distance. When the sum includes a decimal, this latter value is found separately in the tables and must be added to the area found for the whole number.

THE DISCHARGE OF THE MISSISSIPPI RIVER. By William Starling, M. Am. Soc. C. E. Transactions of the American Society of Civil Engineers. Vol. XXXIV.; No. 5.

There is so much interesting and valuable matter in this paper that we notice it here for the purpose of bringing it to the attention of those not members of the American Society of Civil Engineers. Mr. Starling is thoroughly familiar with his subject from long years of experience on the Mississippi River. He reviews the work of previous investigators, carefully describes the region effected by floods, and the difficulties to be encountered, and then elaborately details the methods of measurements and the results obtained. The paper is particularly interesting from the intricate conditions surrounding the problem, caused by the great lateral basins of overflow, the rapid change of channel area, etc. This paper can be obtained for $1 by addressing Mr. C. W. Hunt, Secretary Am. Soc. C. E., 127 E. 23d St., New York.

TRADE PUBLICATIONS.

THE CYANIDE PROCESS AND THE CYANIDE PATENTS. A Guide to Relief from Royalty. By George G. Turri, F. M. I. P. A., Patent Agent, Melbourne, Australia. Pamph., 6 × 9 ins., pp. 17. 1 shilling.

This pamphlet contains a reprint of an article on the "Cyanide Terror," a history of the cyanide process of extracting gold from its ores, and an argument that the patents on the process are invalid.

GAS AND OIL ENGINES. The Raymond Improved Gas and Oil Engine, Single, Double and Quadruple Cylinder, 1 to 100 HP. actual. J. I. Case Threshing Machine Co., Racine, Wis. Pamph., 8½ × 7 ins.; pp. 32.

This is an illustrated catalogue of the gas engines manufactured by this well-known concern. At present ten sizes of single cylinder engines are built, rated at from 1 to 20 HP; also ten sizes of double cylinder engines rated at 4 to 50 HP., and three quadruple cylinder, of 60, 85 and 100 HP.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago.

AUBURN, GENOA & CHARLESTON CENTRAL.—Incorporated in West Virginia, Dec. 19, to build and operate a steam railway; capital stock, $300,000, all subscribed; to operate at Freeville, N. Y., with branch lines in the state of New York; incorporators, Chas. Thompson, New York city; Wm. E. Ruggles, Syracuse, N. Y.; Frank C. Cove, W. W. Hunt and Wm. W. Scott, of Auburn, N. Y. Both Auburn and Freeville, N. Y., are on the Auburn Division of the Lehigh Valley road.

CINCINNATI & HAMILTON.—The Cincinnati "Commercial Gazette" states that a company has been organized, and surveys and profiles made, for the construction of a railway from McLain Ave. in Cincinnati to Dayton, a distance of about 60 miles. The line will run east of the Big Four, crossing its lines at Lockland, and from thence along the west line of the Miami & Erie Canal to Hamilton; thence along the west bank of the canal to Middletown, Franklin and Miamisburg and Carrollton to its termini at Dayton. Options on the right of way have been secured of a portion and a part of the line has been staked and is now ready for grading. Ex-Governor James E. Campbell has been selected as general counsel of the company, and C. F. Gunckel assistant counsel. Peter Schwab, of Hamilton, O., and Senator Calvin S. Brice are mong those interested.

CINCINNATI, HILLSBORO & WELLSTON.—Incorporatod in Ohio Dec. 17, with a capital stock of $10,000, to build and operate a railway from Wellston, O., via Hillsboro to Cincinnati; incorporators, M. McKeehan, J. M. Hiestand, H. C. Dawson, Calvin Stroup and J. M. Hughey; principal office at Hillsboro, O.

EMPORIUM & MOUNT JEWETT.—Contracts for constructing this railway, noted in our issue of Oct. 31, will be let at once. We are informed that the line will extend from Emporium through Clermont to Hazlehurst, Pa., 18 miles. The location has been made and capital secured. Pres., Geo. J. Wolf; Ch. Engr., A. G. McComb, both of Bradford, Pa.

LAKE SUPERIOR & ISHPEMING.—This road is now under construction, and not in operation, as stated last week, between Ishpeming and Marquette, Mich., 17.8 miles. S. S. Neff, Ch. Engr., Marquette, Mich.

PENNSYLVANIA.—Wm. H. Brown, Ch. Engr., Philadelphia, informs us that 11 contracts have been awarded, as follows, for straightening curves, reducing grade, etc., on various divisions of this road, as advertised in Engineering News: The Drake & Stratton Co, has the contract for straightening the curves on the Philadelphia, Wilmington & Baltimore R R, between Elkton, Md., and Iron Hill, a distance of three miles. The new track will be comparatively straight where now it is almost one continuous curve. Work will be begun in a short time and promises to give employment to a large number of men the balance of the winter. Between Leaman Place and Kinzer's Station a large curve will be taken out and the roadbed not only straightened but moved further north, necessitating an excavation of 300,000 cu. yds. and embankment of the same number. By the change the distance will be shortened one-third of a mile. B. B. Gonder of Strasburg, Lancaster county, gets the the first section, west of Kinzer's: Pennell & O'Horn of Yonkers, N.Y., the grading of the second section; T. Benton Brown, of Philadelphia, does the necessary masonry for the two overhead, two undergrade, and two arch bridges on this section. Keller & Hook of Lancaster, build the arch bridge over Pequa Creek to accommodate two additional tracks and E. C. Wells, of Philadelphia, the grading and masonry of section three, extending from Pequa Creek through Gordonville to end of present four-track system. Keller & Crossan have put a large force of men at work at Mount Joy. The roadbed will be entirely changed and will pass through the middle of the town from end to end. At a meeting of the Borough Council on Tuesday evening permission was given to the railway company to make the changes. All grade crossings will be avoided, and eight iron overhead bridges will be erected. Kesler & Crossan, of Lancaster, also receive the contract for straightening the line between Rheems and Elizabethtown, which includes a very heavy rock cut, and takes out a bed reversion in the line. On Pittsburg Division, the change of line between Lilly and Portage will save over a mile in distance, and over 400° of curvature. Section one was awarded to P. McManus, of Philadelphia; section two to W. C. Stall & Sons, of Altoona; section three to Chas. A. Sims & Co., of Philadelphia; section four to Gaynor & Quinn, of Pottsville; section five to P. McManus. This is a very heavy piece of work, but by making five contracts of it, it is expected to complete the whole of it by July of next year. The change of line at Ninevah was awarded to the Drake & Stratton Co., which was also the successful bidder for the new tunnel at Radebaugh, west of Greensburg. This tunnel will be 2,100 ft. long, and save about one-quarter of mile in distance and over 100°. These improvements were described and illustrated in our issue of Dec. 12.

JEROMESVILLE.—Press reports state that surveys have been completed for extending to Wooster the railway being built by H. B. Camp, of Akron, O. The road is already in operation for freight traffic from Shreve to Jeromesville, 14 miles, as noted in our issue of Oct. 24.

LOUISVILLE, NEW ALBANY & CHICAGO.—This company is reported as contemplating the construction of a branch, which will leave the main line between Limedale and Putnamville, Ind., pass in a southwest direction through Clay county, and probably have its terminus at Linton in Greene county. Ch. Engr., F. Hall, Chicago.

SMETHPORT & OLEAN.—Contracts will be let at once for building this railway from Smethport, Pa., to Portville and Olean, N. Y., a distance of 26 miles. The company was incorporated Dec. 5 with a capital stock of $400,000, as noted in our issue of Dec. 12, and we are informed that the line has been located and the capital for the construction all secured. The officers are the same as of the Emporium & Mount Jewett, previously noted. Ch. Engr., A. G. McComb, Bradford, Pa.

SOUTH JERSEY.—This company is reported as preparing to build an eight-mile branch to Ocean City, N. J. F. J. Gowen, Receiver, Philadelphia.

WASHINGTON CONNECTING.—Incorporated in Pennsylvania Dec. 17, to build a steam railway from Canton township, Washington county, to a point near the Tyler Tube Works, on the Chartier Valley Ry.; capital stock, $30,000, with $3,000 paid in; Pres., Wm. H. Hays, Pittsburg.

Southern.

HARRIMAN & NORTHEASTERN.—Incorporated in Tennessee by the reorganization committee of the East Tennessee Land Co., and covering the company's line in Roane and Morgan counties and the narrow gage on the south side of the river; Pres., I. K. Funk, New York.

NORFOLK & WESTERN.—This company is reported about to double-track five miles of its line betweeen Lyck Branch and North Fork Junction, W. Va., and it is stated that the contract for the first one-mile section has been awarded to John Sexton, of Roanoke, Va.

SPARTANSBURG & HENRIETTA.—Efforts are being made at Spartansburg, S. C., to secure the construction of a railway to Henrietta, N. C., on the Seaboard Air Line. The distance is 26 miles, and it is expected that the money for the grading will soon be raised.

Northwest.

WASHBURN, BAYFIELD & IRON RIVER.—We are informed that this railway is projected from Bayfield, via Washburn to Iron River, Wis., a distance of 66⅓ miles. The surveys have been completed and Bayfield county has voted $240,000 in bonds to aid the construction. The right of way is now being secured. It is not known when contracts will be awarded. Pres., W. E. McCord, Chippewa Falls, Wis.; Ch. Engr., Geo. L. Davis, Grand Rapids, Mich.

Southwest.

CHICKASAWBA, LUXORA & GILMORE.—Incorporated in Arkansas, Dec. 14, to build a railway from the town of Chickasawba to Luxora, Ark., 12¼ miles; capital stock, $100,000; incorporators, B. A. Bugg, L. W. Gosnell and others.

Rocky Mt. and Pacific.

CALIFORNIA EASTERN.—Those interested in the reorganization of the Nevada Southern, now the California Eastern, are reported to have decided to commence work soon on the proposed extension from Manvel, Cal., to Good Spring, and it is probable that further extensions will be made into Southern Nevada and Utah. Robt. Seibert, Receiver, Manvel, Cal.

SAN DIEGO, PACIFIC BEACH & LA JOLLA.—C. D. Boyd, Gen. Supt., San Diego, Cal., is reported as awarding contracts for extending this railway about 50 miles.

UNION PACIFIC, DENVER & GULF.—Colorado papers state that the old Colorado Central road will probably be rebuilt between Fort Collins and Cheyenne and about six miles of new road be built between La Salle and Greeley. The condition of the entire system is much improved and the road is now in better shape than ever before. F. Trumbull, Receiver, Denver, Colo.

STREET AND ELECTRIC RAILWAYS.

ELLSWORTH, ME.—Geo. E. Macomber, of Augusta, Me., has submitted a proposition for the construction of an electric railway from Ellsworth Falls to this city.

BENNINGTON, VT.—The Bennington & Woodford Electric Ry. Co. has decided to spend $20,000 in extending its road to Glastenbury, 4½ miles, and it is stated that a number of other improvements will be made.——It is stated that surveys have been completed for the proposed electric railway to North Bennington and Hoosic Falls, N. Y., 8½ miles, and that contracts for the construction will soon be awarded.

SPRINGFIELD, VT.—Surveys are being made for an electric railway to Charlestown, N. H. It is proposed to build a standard gage road in order that freight can be hauled over it. A steam railway has been projected from this place for several years, and several surveys have been made. It is stated that Boston parties have offered to build the electric railway provided the charter granted to the Springfield Electric Ry. Co. by the last legislature is transferred to them.

BOSTON, MASS.—A local paper states that a railway deal is under consideration which contemplates a syndicate to control the West End St. Ry. system and which will proceed to the construction of an elevated road, under the Meigs' system somewhat modified. Henry M. Whitney, Willard Howland, and George H. Towle are mentioned in connection with the scheme.

DEDHAM, MASS.—The selectmen have granted a franchise to the Norfolk Central St. Ry. Co. for an electric road, 10 miles long, from Dedham Centre to East Walpole with a branch to West Dedham; capital stock, $75,000; directors, Hon. John R. Bullard, Thomas T. Robinson, Henry C. Delano, Dr. John W. Chase and Ferdinand F. Favor, all of Dedham; Francis Doane, of Norwood, Mass., and A. A. Whittier, of Boston. It is thought that the road will be ready for operation by July.

SHELBURNE FALLS, MASS.—Maynard & Sprague, 9 Maple St., Springfield, Mass., have prepared plans for the proposed electric road to Colrain, estimated to cost $50,000 without the equipment. Estimates for the overhead work and equipment will soon be received.

COHOES, N. Y.—The Cohoes City Electric R. R. Co. has just completed the Johnson Ave. bridge, thereby opening its belt line around the city. The company has also completed its extension toward West Troy as far as the city line of Cohoes, and the remaining 1¼ miles will be built in the spring, connecting at Congress St. bridge, West Troy, with the Troy-Albany Electric R.R.

NEW YORK, N. Y.—The American-China Development Co. filed articles of incorporation at Trenton, N. J., Dec. 20, to operate railways, steamship, telegraph and telephone lines in China; capital stock, $1,000,000. Among the incorporators are Frank Trenholm, of New York; D. H. Lyon, of Greenwich, Conn., and S. S. Walters, of Jersey City.

ROCHESTER, N. Y.—The Windsor Beach & Summerville Electric R. R. Co. has been incorporated to build a line from Forest Lawn to Summerville, along the lake shore, six miles. The road, the report says, is to be completed by July. E. O. McNair, of Warsaw, N. Y., and Edward Elwanger, A. J. Johnson and J. C. Tone, of Rochester are interested.

JERSEY CITY, N. J.—The Sprague Electric Ry, Co. has been incorporated to construct railways, light and power plants, etc.; capital stock, $1,000,000, with $1,000 paid in; incorporators, Frank J. Sprague, Chas. M. Sprague, Chas. A. Benton, of New York; Edward C. Platt, of Brooklyn, N. Y, and Howard F. Gurney, of Jersey City.

CORRY, PA.—S. J. Franklin, Ch. Engr. Corry St. Ry. Co., Warren, Pa., writes us that the right of way will be secured and surveys made in January. The capital for the construction of the road, which will be four miles long, has been secured. The time for letting the contracts has not been set but it is expected to have the road in operation by June. Pres., Manley Crosby, Corry.

GREENSBURG, PA.—Press reports state as follows: An electric railway is to be built, starting at Derry, thence to Latrobe, to Youngstown, three miles to the south, to Whitney, and the extensive Lippencott and Hostetter coke plants, and to St. Xavier's Academy, about 20 miles in length. Among the parties interested are Col. Hugh Keogh, of Lancaster, S. H. Miller and E. Saxman, Man. Saxman Coal & Coke Co., of Latrobe.

JENKINTOWN, PA.—Plans are being made for an extension of the York St. Rv., through Jenkintown and the property of the Wharton Switch Co. to a point on Willow Grove pike, and from there to Glenside. Another line will come up over the route surveyed several years ago for the Philadelphia & Northern R. R., from Wister Station to Glenside. It is said that the contract for the construction of this line has already been awarded, and that it will be built next summer. Supt., C. E. Long, York, Pa.

LANGHORNE, PA.—The Newtown, Langhorne & Bristol St. Ry. Co. has secured the right of way for its electric road, about 12 miles long, from Bristol to Langhorne. We are informed that the contract for the section from Langhorne to Langhorne Manor, including outside construction and car equipment and power-house has been awarded to G. S. W. Brubaker, of Lancaster, Pa. The outside construction is nearly completed and the road will be in operation early in January. Pres., Henry W Watson, Langhorne; Ch. Engr., J. H. Terry Philadelphia.

PITTSBURG, PA.—The Pittsburg, Braddock & McKeesport Ry. Co. has been incorporated to build an electric road; capital stock, $66,000; Pres., C. H. Johnston, Pittsburg; directors, John C. Miller and Wm. Robinson, Pittsburg.——A charter was issued recently to the City Incline Plane Co. to build a passenger incline plane from a point on Fourth Ave. over the Monongahela River, to the top of Mount Washington. The company starts out with a merely nominal capital stock of $1,000, and with J. W. Patterson, E. K. Morse, Engr., 706 Penn Bldg., Pittsburg; James F. Grimes, Gen. Man. Knoxville Land & Improvement Co.; Webster W. Murray, Pres. St. Clair Water Co.; John P. Moore, Gen. Supt. Knoxville Land & Improvement Co., as directors. Plans have been prepared for a structure 3,500 ft. long and 40 ft. wide, with double tracks and with a grade of between 9 and 10%. The plans include a suspension span over the Monongahela River of 1,300 ft. The towers at each end will be 250 ft. high. The floor at Carson Ave. will be about 200 ft. above grade while at the Mount Washington end it will be 350 ft. high. The estimated cost is $1,000,000.

PHILADELPHIA, PA.—J. C. McNaughton, 2034 Race St., Philadelphia, has petitioned the council for permission to construct the Enterprise St. Ry., the East Philadelphia St. Ry. and the Western Philadelphia St. Ry., all covering a total of about 50 miles of streets. Charters were granted to the companies for the construction of these lines on May 14, 1889.

CHARLESTON, W. VA.—The Charleston Electric Ry. & Power Co. has been incorporated, with a capital stock of $500,000; directors, Neil Robinson, E. S. Buttrick, D. W. Patterson and F. H. Markell, Charleston.——The Charleston Traction, Light & Power Co. has been incorporated, with a capital stock of $500,000, by W. A. MacCorkle, Malcolm Jackson, M. M. Williamson, of Charleston.

LOUISVILLE, KY.—Estimates are wanted for the construction of the proposed 30-mile electric road between Louisville and Fairfield, and for equipping the road. Ch. Engr., Rowland Cox, care of W. B. Hoke, 436 West Jefferson St., Louisville.

HICKSVILLE, O.—James B. Colgrove, of Washington, D. C., Pres. Fort Wayne, Hicksville & Bryan Electric R. R. Co., has been granted the right to use the streets of Fort Wayne, Ind., and the county commissioners will no doubt grant the use of the public highways. All the preliminary preparations have been made and as soon as sufficient stock is sold, it is stated that preparations for construction will be made.

FORT WAYNE, IND.—A Cleveland, O., syndicate is said to have closed a deal by which the entire street railway system of this city goes into its hands. The new company will be known as the Consolidated Electric R. R. Co., embracing all the lines in Fort Wayne. The capital stock is $1,500,000 and a mortgage of $1,500,000 has been filed to cover the bonds of the company. It is stated that the Cleveland syndicate will expend at once $300,000 in improving the property, extensions and additional equipment being intended. Pres. John J. Shipperd, Pres. Evansville St. Ry. Co., Evansville, Ind.

HUNTINGTON, IND.—It is stated that W. E. Avery and E. Hunt, of Detroit, Mich., were registered at the Exchange Hotel Dec. 15, being here in the interest of the proposed Huntington, Columbia City & Ligonier Electric Ry. Work was to be begun on Dec. 17 grading the line, and a gang of men now at work grading on a line near Peru will be brought here and put to work.

ISHPEMING, MICH.—Press reports state as follows: Hiram A. Burt, projector of the Marquette & Iron Range Ry., has a plan that a company will soon test for building a line to Marquette, 15 miles. There is a fall of 800 ft. to Marquette, and Mr. Burt proposes to make the road a trolley line, without a power plant. Each train will have a motor car fitted with a dynamo. All the energy created by gravitation as the loaded trains descend will be converted into electricity, except as much as is required to carry the train along at a fair rate of speed. This power will then be transferred to the empty train going up the hill. The difference between the weight of the loaded and empty trains will overcome the loss by friction.

CHICAGO, ILL.—The Englewood & Chicago Electric St. Ry. Co. has secured a permit from the commissioner of public works to construct tracks, under an ordinance passed in May, 1893, by the council. The road is to be in Hyde Park and the Town of Lake, covering in the latter district the extreme southwestern portion of the city. The capital stock has been increased from $1,500,000 to $2,000,000. Pres., E. F. Cragin.

ELGIN, ILL.—W. S. Gamble, Elgin, has made surveys for the Carpenterville, Elgin & Aurora Electric Ry., through Clintonville, Coleman, St. Charles, Geneva and Batavia to Aurora, 24 miles. The construction, we are informed, will be begun at once.

WATERLOO, IA.—The Waterloo & Cedar Falls Rapid Transit Co. has been incorporated to construct a street railway between Cedar Falls and Waterloo. Capital stock, $600,000. Incorporators: C. J. Fasselman, J. H. Bowman, L. S. Cass and J. H. Rafferty.

MANKATO, MINN.—We are informed that an electric railway is now under consideration. It is proposed to give the city lighting to any strong company which will build the street railway here, which with commercial lighting and furnishing power will make a good business for a company. M. B. Haynes, Cy. Engr.; Calvin Smith, Cy. Clk.

SOUTH SIOUX CITY, NEB.—The South Sioux City Traction Co. has been incorporated with a capital stock of $50,000, by T. L. Eaton, Henry J. Taylor, C. A. Benton, D. L. Plumer and E. H. Burgess.

COLORADO SPRINGS, COLO.—It is reported that the Cripple Creek Electric Car & Power Co., composed of Pittsburg capitalists, has been organized. The company proposes to connect Cripple Creek with Colorado Springs and Canon City; also to furnish power to the mines. Another company has been recently organized to connect the railways with various paying mines scattered about the camp for freight as well as passenger traffic. The latter system will be 35 miles long.

TERRELL, TEX.—It is reported that E. H. R. Green, Pres. Texas Midland R. R., is figuring on the practicability and probable cost of operating trains on the road by electricity.

CHICO, CAL.—Press reports state as follows: The project of building an electric railway from Biggs to Palermo and Honcut, crossing the Feather River near the Alexander & Hamman and W. Treat & Son division line, is under consideration. This would necessitate a bridge across the river, which is needed for a public wagon way, as well as for an electric railway. The same line extending from Biggs to Gridley and from Palermo to Oroville, thence to Chico, would make a complete connection of all the principal towns in the county, and its construction is a probability.

OAKLAND, CAL.—E. P. Vandercook, of this city, is making arrangements for a projected electric railway from Oakland to Livermore and Corral Hollow.

SAN JOSE, CAL.—W. T. Weber, of Burlington, Ia., has proposed a plan for constructing an electric road to Saratoga and Palo Alto, estimated to cost $200,000. If the people along the route will subscribe $60,000 an eastern syndicate will put up the remainder. It is stated that work can be begun at once.

MONTREAL, QUE.—The Montreal St. Ry. Co. has petitioned for permission to extend its road up Mount Royal to the park. Pres., M. J. Forget; Man., G. C Cunningham.

QUEBEC, QUE.—Press reports states that at the last meeting of the Montmorency Electric Light & Power Co, it was decided to accept the offer of the American capitalists backing H. J. Beemer. The total stock represents $400,000 at its par value, and for this the shareholders receive $600,000, at the rate of $150 per share. The undertaking will now be fused into the company which Mr. Beemer has organized to take over the Quebec & Montmorency Ry., and to build and run his Quebec electric street railway, and will have a capital of $2,000,000.

RIDGEWAY, ONT.—The Crystal Beach Improvement Co. has decided to build an electric railway between Crystal Beach and Ridgeway, a distance of two miles, according to reports.

ELECTRIC LIGHT AND POWER.

TAUNTON, MASS.—The council is considering the question of a municipal electric light plant.

NEW ROCHELLE, N. Y.—Geo. T. Davis, of the citizens' committee, writes us that the question of an electric light plant is now under investigation.

ROCHESTER, N. Y.—The board of supervisors recently received bids from the following for equipment for lighting the new court house with either electricity or gas, to cost $18,000: Archer, Pancoast Co., New York; Acme Gas Fixture Co., Bridgeton, N. J.; Mitchell, Vance Co., New York; C. K. Summerhays Co., Rochester; De Kosenco & Hetherington Mfg. Co., Philadelphia, Pa.; Oxley & Enos Mfg. Co, New York; J. B. Snyder, Rochester. Some of the firms made two bids, but all at $18,000.

TULLY, N. Y.—H. W. Ring, Village Clk., writes us that on Dec. 21, by a vote of 28 for to 23 against, the village decided in favor of electric lights.

HUBBARD, O.—Bids are asked until Dec. 30 for constructing an electric light plant. John Powers, Clk.

SMITHVILLE, TEX.—Plans and bids are asked for an electric light plant and water-works. M. Burleson, Secy. Smithville Town Co.

COLTON, CAL.—Bids are asked until Jan. 6 for constructing an electric light plant. Elec. Engr., E. O. Sharpe, Riverside, Cal.

RIVERSIDE, CAL.—Bids are asked until Dec. 30 for constructing an electric light plant. Elec. Engr., E. O. Sharpe, Riverside.

LOS ANGELES, CAL.—Bids are asked by the board of supervisors until Jan. 22 for a franchise for the transmission of electric power from Kern River, in accordance with the application of Chas. Forman and others.

TRENTON, N. J.—Bids are asked until Jan. 1 for lighting the streets for one to three years. C. E. Murray, Cy. Clk.

PHILADELPHIA, PA.—The council has voted to set aside $62,000, the balance of the electric light appropriation, for a fund for a municipal electric plant.

CHARLOTTSVILLE, VA.—It is stated that the Charlottesville & University of Virginia Electric Light and Gas Co. has made a proposition to light the city.

DUBLIN, GA.—Albert R. Arnan, Cy. Clk., writes us that an election will be held Jan. 12 to vote on the question of issuing $25,000 of 30-year bonds for electric lights and water-works.

HENDERSON, KY.—Pierce & Richardson, Manhattan Bldg., Chicago, Ill., are reported as having been engaged by the council to prepare plans for an electric light plant. It is probable that bids will soon be asked for constructing the power house. H. B. Hart, Chm. Com.

WAY CROSS, GA.—The Satilla Mfg., Way Cross, proposes to purchase a 1,000-light incandescent dynamo, 50-light arc dynamo, 150-HP. engine and two 60 to 80-HP. boilers, according to reports.

GAINESVILLE, FLA.—H. E. Taylor, J. M. Graham and F. W. Cole, it is stated, have asked the council for a franchise.

ALEXANDRIA, LA.—It is reported that the municipal electric light plant is to be enlarged, and new boilers, dynamos and engines purchased.

LEXINGTON, KY.—Bids are asked until Jan. 1 for constructing an electric plant of about 400 arc lights capacity. H. T. Duncan, Mayor; J. M. Roche, Secy. Ky. Water, Heating & Illuminating Co.

MARQUETTE, MICH.—The light and power commission, we are informed, has been allowed $4,000 for improving the light plant.

CASEVILLE, MICH.—The Caseville Electric Lighting Co. has been organized, and, it is stated, will soon begin work upon a plant.

MADISON, IND.—R. E. Richardson, of Pierce & Richardson, Elec. Engrs., 1409 Manhattan Bldg., Chicago, Ill., is making estimates for an electric light plant and railway for this place.

MANKATO, MINN.—The city wishes to contract for electric lighting, as noted more fully under Street and Electric Railways. M. B. Haynes, Cy. Engr.

ST. PAUL, MINN.—L. W. Rundlett, Cy. Engr., is reported as having been directed to prepare estimates for a municipal electric light plant.

BEATRICE, NEB.—The council has called an election for Jan 31 to vote on the questions of issuing $10,000 in bonds for an electric light plant.

WESTPORT, MO.—The question of issuing $75,000 in bonds for an electric light plant, water mains, etc., is being considered according to reports.

OGDEN, UTAH.—Rhodes Bros., Denver, Colo., are said to have been awarded the contract by the Pioneer Electric Power Co., for the construction of a water power plant. The entire plant will include a dam 450 ft. long, a power house with 10 1,000-HP. dynamos, six miles of 6-ft. pipe, and is estimated to cost $1,250,000. Work will be begun in the spring. Secy. and Treas., C. K. Bannister, Ogden.

BEEVILLE, TEX.—A company has been organized to build an electric light plant. Geo. W. Greathouse is interested.

MEXICO, MEX.—Press reports state as follows: Manuel Fernandez Leal, Sec. Dep. Fomento, in behalf of the Executive, has entered into a contract with W. Breckman, representing Siemens & Halske, of Chicago, Ill., for the transmission of water power to this city and other states from the falls in the municipality of Tenancingo. By the terms of the concession the concessionaires agree to utilize the hydraulic force produced by the falls of San Simon Atlocomulco and Achayatla for the purpose of transmitting and generating electrical energy to this city, the Federal district and neighboring states.

NEW COMPANIES.—Charleston Traction, Light & Power Co., Charleston, W. Va., $500,000; W. A. MacCorkle, Malcolm Jackson, M. M. Williams, A. W. Watrous, Charleston.

La Capital Co., Portland, Me.; $1,500,000, to carry on the business of electric lightning and heating; Theo. N. Vail, Lyndon, Vt.; Treas., Francis A. Houston, Boston, Mass.

Walker Company, of Cleveland, O.; $2,500,000, with $2,000 paid in; to manufacture electric generators and motors and all other kinds of electrical apparatus; $2,500,000; John Ludwig, Brooklyn, N. Y.; Chas. N. King, and Martin W. Dixon, Jersey City, N. J.

Norfolk Electric Light & Power Co., $15,000; Paul K. Boyd, B. N. Sperry, Geo. Russell.

Consolidated Water & Electric Light Power Co., Sheffield, Ala.; $250,000; this company through E. F. Euslen was granted a franchise to supply water and light as noted in our issue of Nov. 28. Pres., E. F. Euslen, Birmingham, Ala.; Secy. and Treas., C. B. Ashe, Sheffield; directors, L. A. May, F. V. Evans, W. R. Brown.

Lord Electric Co., Boston, Mass.; $15,000; to to manufacture electric appliances, etc; Pres., Fred W. Lord; Treas., Thos. P. Curtis, of Boston.

BRIDGES.

BELFAST, ME.—We are informed that plans have been prepared for the proposed bridge over Belfast Harbor, but no money has yet been appropriated. L. H. Murch, Cy. Clk.

BANGOR, ME.—The Maine Central R. R. Co. has been authorized to build a $10,000 steel bridge over its tracks at Veazie lower crossing, according to reports.

NEWTON, MASS.—H. D. Woods, Cy. Engr., writes us as follows about the bridges for the depression of the tracks in Newton, mentioned in Engineering News: These structures are highway bridges over a four-track road. They are to be of steel with solid floors, the floor system in most cases being only 18 in. in depth, head room above the track 16 ft. These bridges are to be constructed by the Boston & Albany Ry. Co.

LONG ISLAND CITY, N. Y.—It is stated that the supervisors of Queens and Kings have been directed by the war department to begin the construction of the Newton Creek bridge at once, and that if work is not begun at once the department will build the structure. The bids, together with a description of the proposed structure was published in our issue of Aug. 8.

ROCHESTER, N. Y.—Chas. N. Bastable writes us that the supervisors do not intend to build a bridge over the Genesee River at Rush, as was reported in local papers.

PATERSON, N. J.—The construction of a new bridge at West St. is being considered. Geo. F. Fenerstein, Freeholder, may be able to give information.

EASTON, PA.—A cantilever bridge of two spans of about 300 ft. each is to be built over the Delaware River at this point, according to reports. The plans were prepared by Prof. J. M. Portes, of Lafayette College, Easton, for the Delaware Bridge Co.

HARRISBURG, PA.—Nelson & Buchanan, Chambersburg, Pa., have been awarded the contract for a bridge 100 ft. long to cross the tracks of the Northern Central R.R. at Bridgeport. The Harrisburg & Mechanicsburg Electric Ry. Co. will build the bridge.

OIL CITY, PA.—A. T. Hyde, Cy. Engr., writes us that the County Commissioners at Franklin, Pa., will build an iron bridge of one span of 180 ft. on foundations already completed at Center St., Oil City.

WILKESBARRE, PA.—Bids will probably be received in the spring for a viaduct 1,075 ft. long over the railway tracks for the Wilkes-Barre & Wyoming Valley Traction Co. Ch. Engr., W. H. Sturdevant.

DANVILLE, VA.—Bids are asked until Jan. 6 for constructing an iron or steel bridge with stone abutments, according to reports. Address P. B. Farmer or R. A. James.

CLEVELAND, O.—It is reported that the river improvement commission has indorsed Mayor McKison's plan to build a new bridge across the railway tracks at the foot of Seneca St. and to drive a line of piles 225 ft. into the lake.

CINCINNATI, O.—Frank Krug, County Engr., estimates the cost of a bridge over Muddy Creek, in Green township, at about $2,510.

INDIANAPOLIS, IND.—The county commissioners will soon be petitioned to build a bridge over White River, near the Hyde Farm.——The bids for constructing the steel bridge over White River, near the southern limits of the city, have been returned by the county commissioners. No work will be done before spring. J. T. Hunter, Clk. Co. Bd.

DETROIT, MICH.—Press reports from Washington state as follows: Senator McMillan introduced a bill authorizing the Michigan Central Bridge Co. to construct a railway bridge across the Detroit River at Detroit. The bill provides that the bridge shall consist of three unbroken spans between the bulkhead lines on the two sides of the river. The length of the main channel span is to be not less than 1,100 ft. in the clear. Only two piers are allowed inside the bulkheads and they are to be located by the secretary of war.

RICHMOND, IND.—The city engineer has submitted preliminary plans for a new bridge, 620 ft. long, over White River at Main St.

GREEN BAY, WIS.—Bids are asked by the council, until Jan. 10, for building a steel drawbridge on stone abutments, with a center pier span of about 157 ft. long and 28 ft. wide. Jos. F. Rothe, 318 North 11th St., Green Bay.

ROCHESTER, MINN.—Bids are asked until Jan. 7 for constructing a steel bridge over the Zumbro River. The bridge will be of one or two spans, and about 200 ft. long, on masonry foundations. C. H. Wagoner, Clk.

ELK POINT, S. DAK.—We are informed that it is proposed to construct a bridge over the Sioux River, between Union County, S. Dak., and Plymouth County, Ia. Address the county commissioners.

PLATTSMOUTH, NEB. — Press reports state as follows: The Burlington & Missouri River R. R. Co. is making arrangements to protect the bridge across the Missouri River at this point, as the river has been and is now cutting the bank away at a rapid rate just above the structure and opposite this city.

DENVER, COLO.—The Gunnison River Bridge Co. has been incorporated to build a bridge over the Gunnison River at Delta, capital stock, $10,000; incorporators, Henry Kohler, Jesse C. Hart and F. H. Bullen.

KANSAS CITY, MO.—F. J. O'Flaherty, County Surv., writes us that the contract for an iron bridge of two deck spans of 33 ft. and 40 ft. respectively, and also 20-ft. steel I beam approach, has been awarded to the Kansas City Bridge Co., at $774. All work of this kind is awarded by public outcry and a record is kept only of the successful bid.

WACO, TEX.—The city secretary writes us that there has been no action taken on the question of constructing a bridge over the Brazos River by the commissioners, as was reported in local papers, and from present indications there will not be anything done for some time.

INDIANAPOLIS, IND.—Bids are asked by the board of public works until Jan. 3 for the construction of the superstructure of the plate girder bridge on Meridian St., over Pleasant Run. The bridge is 78 ft. span, 30 ft. roadway, 6 ft. sidewalks; girders, 7 ft. 6 in. deep, $\frac{1}{2}$-in. plate; floor beams, 36 in. deep, $\frac{5}{16}$-in. plate; brackets for sidewalks stringers 12 in. and 7 in., I-beams, 32 and 15 lbs. a ft; floor, 3-in. oak on roadway, 2-in. on sidewalk; bridge designed for 100 lbs. a sq. ft. on roadway and 80 lbs. on sidewalk.

EL DORADO SPRINGS, MO.—It is reported that the new $14,000 bridge over the Sac River at this place has been carried away by high water.

TOPEKA, KAN.—Keepers & Thacher, 33 Telephone Building, Detroit, Mich., have been directed to prepare plans for a Melan arch bridge over the Kansas River, estimated to cost about $135,000. It is stated that the plans will be ready early in February, after which bids will be asked by the county commissioners.

BUILDINGS.

WATERVILLE, ME.—The construction of a new city hall, estimated to cost $50,000, is being considered, according to reports.

NEWTON, MASS.—An architect will probably soon be engaged to prepare plans for a $150,000 high school building. Address Henry Tolman, 41 High St., Boston.

HARTFORD, CONN.—A new city hall to cost $90,000 is reported as in contemplation.

WATERBURY, CONN.—John Moriaty is interested in a $125,000 theater to be built on Main St., near Centre.

ALBANY, N. Y.—I. G. Perry, State Arch., has submitted seven specifications for the completion of the capitol building. Some changes will be made, after which bids will probably be asked for the work.

BUFFALO, N. Y.—Bids are asked until Jan. 3, for constructing a 16 room school building at Delavan Ave. and Moselle St. R. G. Parsons, Secy., Bd. Pub. Wks.——Richard A. Waite, German Insurance Bldg., Buffalo, has submitted plans for a fourth story and two 4-story wings estimated to cost about $750,000.——F. C. H. Mohr, 265 Utica St., has prepared plans for a 6-story brick, stone and terra cotta building for an Odd Fellows Home on the north side of William St., east of Jefferson St. It will be built on the steel construction plan. Estimated cost $50,000.

BINGHAMTON, N. Y.—The county supervisors have directed the committee on public buildings to advertise for bids for constructing a new jail.

NEW YORK, N. Y.—Plans have been filed by the Commercial Cable Bldg. Co., 253 Broadway, for a 21-story office building at 18 and 20 New St. and extending through the block to 20 and 22 Broad St.; estimated cost $1,000,000; Archs., Harding & Grooch, 253 Broadway; by Alexander Brown, Jr., 245 West 54th St., for a six-story brick building at Jay and Staple Sts. for a fruit exchange to cost $100,000; by the Colonial Real Estate Association, 349 Broadway, for a 10-story brick store building at 53 to 57 West 14th St., to cost $250,000; and by Donald Mackay, of Englewood, N. J., and of Vermilye & Co., bankers, New York, for an 18-story stone and brick building at Nassau and Pine Sts. to cost $350,000. A 5-story brownstone building now stands on the site, which will soon be torn down. Arch., John R. Thomas, 160 Broadway.——A. S. Townsend, 1,300 Broadway, has prepared plans for a $500,000 office building.——Brunner & Tyron, 36 Union Square, have prepared plans for a $300,000 temple.

PATERSON, N. J.—Judge James Inglis, Jr., of Paterson; Moses E. Worthen, of Passaic, and Geo. Wurts, of Paterson, have been appointed a committee to superintend the erection of a county court house 250 × 200 ft., to cost $200,000.

BEAVER FALLS, PA.—A movement is reported to build a large hotel at 7th Ave. and 11th St. John White and J. F. Howarth are interested.

McKEESPORT, PA.—R. E. Stone has had plans prepared for an office building 114 ft. high, to cost $100,000, on Market St.

PITTSBURG, PA.—Henry Phipps, Jr., has given $50,000 to build an addition to the Phipps Conservatory in Schenley Park. The plans for this new wing will soon be finished. Edward M. Bigelow, Dir. Pub. Wks.

CLEVELAND, O.—John Eisenman, Arcade Bldg., Cleveland, has prepared plans for a large government building in this city, according to reports.

COLUMBUS, O.—D. H. Burnham & Co., Rookery Bldg., Chicago, Ill., are preparing plans for a three story station, 500 × 100 ft., for the Pennsylvania Co., to cost about $500,000. Work will probably be begun in the Spring.

PEORIA, ILL.—Bids are asked until Jan. 4 for constructing the Illinois asylum for the insane. Henry Alexander, Secy.

CHICAGO, ILL.—Press reports state as follows: The Northwestern University trustees have decided to erect a modern office building on the university portion of the old Grand Pacific Hotel site, corner of La Salle and Jackson Sts. At a meeting of the trustees Dec. 14, at the residence of Orrington Lunt, in Evanston, a quorum of the university building committee instructed Dr. R. D. Sheppard, the business agent of the university, to prepare plans for a building. The structure will be about 10 stories high and will cost about $1,500,000.

DULUTH, MINN.—The city clerk has been directed to advertise for bids for erecting an armory and market house. Archs., Radcliffe & Willoughby.

JEFFERSON CITY, MO.—It is reported that it is proposed to issue $60,000 in bonds for a new court house.

DALLAS, TEX.—A. B. Bristol, Jr., Arch., has plans for two warehouses to cost $80,000 and $60,000 each, work on which will be begun soon, according to reports.

SAN FRANCISCO, CAL.—The harbor commissioners received the following bids for the construction of the new union station and ferryhouse, estimated to cost about $600,000. Masonry—C. F. McCarthy, $167,000 to $218,000; M. McGowan, $232,900 to $247,-

500; John McCarthy, $233,740 to $246,500; Richardson & Gale, $242,950 to $291,657; Thomas Butler, $234,933 to $290,353; Miller & Beck, $246,540 to $258,540; Rae Building Co., $256,715 to $275,026; J. H. Mackay, $268,000 to $283,000. Wrought, steel and cast-iron—Risdon Iron Works, $188,000; C. F. McCarthy, $199,645; San Francisco Bridge Co., $208,863; Colton Bros. & Co., $208,000; Western Iron Works, $209,700; Ralston Iron Works, $216,950; B. P. N. Little, $249,592. Carpentering, plastering and glazing—Bateman Bros., J. H. McKay, C. F. McCarthy, J. W. Wissinger, Concannon & Shay, T. H. Day, Campbell & Peters, M. C. Lynch, T. A. Williams, Alex. Campbell, P. McLachlan, Peter Creighton, Cameron & McDonald. Plumbing and gas fitting—E. J. Duffey, C. F. McCarthy, William S. Wilson, S. Ickelheimer & Brother, W. R. Snook & Sons, H. Williamson, Dalziel & Muller, Edward Hogan, J. Doherty, Sheppard Bros. Roofing, skylights and galvanized iron works—William Cronan, Forderer Cornice Co., Conlin & Roberts, $57,900; Mackay & Gross. Painting—George J. Smith & Sons, J. P. Fraser, W. May, L. J. Dwyer, P. N. Russ, George C. Cotting.

WORCESTER, MASS.—Bids are asked until Jan. 20 for the interior finish, plumbing, approaches, etc., for the post office building in this city, as stated in our advertising columns. Wm. Martin Aiken, Supervising Arch., Washington, D. C.

BINGHAMTON, N. Y.—Bids are asked until Jan. 3 for the plumbing in the main building of the Binghamton State hospital, as stated in our advertising columns. Engr., Wm. Paul Gerhard, 36 Union Square, East, New York; Alexander Cummings, Chn. Trustees.

MURPHY, N. C.—The commissioners of Cherokee county will soon make contracts for the building of a new courthouse, to take the place of the one burned recently. The one burned cost $39,000, and it is thought a new brick and stone structure, to cost about $50,000, will be ordered.

NASHVILLE, TENN.—Plans are asked by the director general of the Tennessee Centennial & International Exposition for five new buildings, to cost from $4,000 to $20,000 each.

SAN FRANCISCO, CAL.—Plans are asked by the regents of the University of California until Jan. 17 for three buildings to cost $250,000 for the affiliated colleges; two sureties of $5,000 each. J. H. C. Bonte, Secy., Berkeley, Cal.

CLEVELAND, O.—Bids are asked until Jan. 14, for constructing a boiler house and tunnel, for the heating and ventilating apparatus and for plumbing, an elevator, etc., for the county court house. Archs., LaBelle & French, Marion, Ind., E. P. McCorkle, Audr. Trumbull county.

DUNKIRK, N. Y.—Bids are asked until Jan. 2, for heating and ventilating the academy building. Arch., W. H. Archer, 85 West Eagle Street, Buffalo; C. M. Reed, Secy. Bd. Education.

RENSSELAER, IND.—The commissionsers of Jasper county have decided to construct a new courthouse to cost $100,000.

ATLANTIC CITY, N. J.—Collins & Autenreith, 410 Walnut St., Philadelphia, Pa., have prepared plans for a 6-story brick hotel to cost $60,000.

MINNEAPOLIS, MINN.—Bids are asked by the board of education until Jan. 15, for the erection of the superstructure for the new high school building at Fremont and 17th Sts. Arch., C. F. Struck, Sykes Block, Minneapolis.

MOBILE, ALA.—Bids are asked by the lighthouse board at Washington, D C., until Jan. 16, for the erection of the Mobile Ship Channel lights, as stated in our advertising columns and as described in our issue of Dec. 12. This letting is postponed from Jan. 2.

WATER-WORKS.

ACTON, MASS.—The water-works proposition was defeated at the recent town meeting.

CLINTON, MASS—A special election will be held Dec. 26 to see if the town will petition the Legislature for authority to issue $50,000 in bonds for water extensions.

RUTLAND, MASS.—Louis M. Hauff, Town Clk., writes us that the water supply for the proposed new works will probably be pumped from a lake to a stand-pipe. The following commissioners have just been elected: C. R. Bartlett, S. W. Trowbridge, William T. Brown, Sr.

STOCKBRIDGE, MASS.—C. H. Pease, Town Clk. of Lee, writes us that the Stockbridge Water Co. has petitioned the Legislature for authority to extend its mains from Stockbridge to South Lee, a distance of about two miles. D. A. Kimball, Man. Water Co.

DANBURY, CONN.—Geo. C. Stevens, Supt., writes us that there will be no extensions of the works this year.

GROTON, CONN.—P. M. Alexander writes us that no steps are being taken to construct works, although it is reported that the question has been discussed.

ANGELICA, N. Y.—H. E. Dudley, Village Clk., writes us that at an election Dec. 7 the taxpayers voted 80 to 37 in favor of issuing bonds for works estimated to cost about $26,000. The supply will be by gravity from a spring five miles distant. It is probable that the works will not be constructed until spring. The commissioners are M. S. Blair, A. K. Fletcher and William Weaver.

BUFFALO, N. Y.—Bids are asked until Jan. 3 for constructing a new conduit and well for the 30,000,000-gallon engine, the removal of the partition wall in the engine room, etc., at the lower pumping station, in connection with the new engine. R. G. Parsons, Secy. Dept. Pub. Wks.

CLIFTON SPRINGS, N. Y.—S. M. Bement, Village Clk., writes us that another election will be held Dec. 30 and that the water question will doubtless be carried by a good majority. At the election Dec. 10 the question was carried by 147 majority out of 230 votes, as noted in our issue of last week.

GLENS FALLS, N. Y.—The village trustees of South Glens Falls have adopted a report of Geo. P. Slade, recommending works estimated to cost about $50,000, and an election will soon be held to vote on an issue of bonds for this purpose. Hermon B. Parks, Pres.

PAWLING, N. Y.—At a recent special election it was decided to raise $10,000 to complete the works.

PHELPS, N. Y.—At a recent village meeting E. D. Smalley, of Syracuse, stated that new works could be constructed for about $25,000 and suggested that in case the old plant is purchased another 6-in. main be laid from the village to the reservoir. It is reported probable that a special election will soon be held to vote on the water-works questions.

GLASSBORO, N. J.—It is reported that over two-thirds of the voters have signed a petition in favor of issuing bonds for municipal works.

DUQUESNE, PA.—The contract for constructing works, as advertised in the Engineering News, has been awarded to Chandley Bros., of Beaver Falls. S. A. Taylor, Engr.

PHILADELPHIA, PA.—Bids are asked until Dec. 30 for water pipe, lead and other supplies. Thos. M. Thompson, Dir. Pub. Wks.

POTTSVILLE, Pa.—Fred. M. Chase, Secy. Sharp Mountain Water Co., recently incorporated, writes us that the company does not contemplate doing any work at present.

WILKESBARRE, PA.—M. B. Williams, Geo. Parrish, S. J. Tonkin and others are reported to have organized the Fern Spring Water Co. to supply water in Laurel Run borough and WilkesBarre township.

WILLIAMSBURG, PA.—The Williamsburg Water Co. was incorporated Dec. 19 with a capital stock of $20,000, commencing with $2,000. Treas., John Clark.

YORK, PA.—Jacob L. Kuehn, Supt. York Water Co., writes us that plans have been completed for the recently reported new reservoir and pumps, etc., purchased under the supervision of the superintendent.

FALLS CHURCH, VA.—It is reported that there is talk of constructing works at this place.

DUBLIN GA.—Albert R. Arnan, Cy. Clk., writes us that an election will be held Jan. 12 to vote on an issue of $25,000 in bonds for water-works and electric lights.

ST. AUGUSTINE, FLA.—The city clerk writes us that the proposed works will cost about $65,000, but that the question of issuing bonds has not yet been voted upon. F. W. Bruce. Cy. Engr.

SHEFFIELD, ALA.—A press report states that the Consolidated Water & Electric Light Co. has been organized with a capital stock of $250,000, and will soon spend $50,000 in improving the plants. Pres., E. F. Enslen, of Birmingham; Secy., C. B. Ashe, of Sheffield.

MADISONVILLE, KY.—Press reports state that the question of issuing $21,000 in bonds for works will soon be voted upon.

NEWPORT, KY.—Contracts for supplies have been awarded as follows: James S. McLane, plumbing and trenching; Alexander Riegler, stop cocks and ferrules; Newport Iron & Brass Co., stop boxes; Geo. B. Holly, lead and lead pipe. John Surran, Supt.

MILFORD, O.—At a recent meeting of the council the building of water-works was declared a necessity. Col. C. L. Greeno, James M. White and Frank O'Connor were appointed a special committee to visit other towns and investigate the question.

TOLEDO, O.—It is stated that the city is about to purchase 2,800 tons of pipe. T. R. Cook, Supt.

WELLINGTON, O.—R. N. Goodwin, Clk., writes us, in addition to our item of last week, that it is not probable that anything further will be done before spring.

REDKEY, IND.—Toney C. Hefel, of West Muncie, has prepared plans for works estimated to cost $42,000, and the committee is now investigating the amount of bonds that can be issued toward the construction.

SULLIVAN, IND.—G. R. Stivers, W. Giles and W. H. Lucas have been appointed a committee on water-works and are now awaiting the development of a well that is being drilled by the Sullivan Woolen Mill Co. Fred Hoke, Cy. Clk.

TRENTON, MICH.—C. H. Kimberk, Village Clk., writes us that a committee has been appointed to investigate the question of issuing bonds and that a board of water commissioners will probably be appointed on Jan. 6.

DECATUR, ILL.—F. L. Hays, Clk., writes us that there has been a good deal of talk about purchasing a new pump, another fire engine, etc., at a cost of about $25,000, but that it is not probable that any of this will be done at present, unless it is to purchase a fire engine.

EDGERTON, WIS.—Henry Johnson, Clk., writes us that nothing has yet been done in regard to water-works and that a suitable proposition is awaited.

WAUWATOSA, WIS.—Bids are asked until Jan. 10 for the purchase of $40,000 of water bonds. Myron Gilbert, Village Clk.

LOHRVILLE, IA.—The city owns a well and is reported as wanting to grant a franchise for works. E. J. Hulett, Cy. Clk.

OSAGE, IA.—W. E. Owen, Cy. Clk., writes us that a mass meeting will soon be held at which it is probable that something definite will be done in regard to the water works question.

STORY CITY, IA.—It is reported that the citizens have voted to issue $5,000 in bonds for works.

MINNEAPOLIS, MINN.—It is reported that about 50,000 ft. of pipe, 111 hydrants, and 64 water gates will be required about Jan. 10. J. H. McConnell, Supt.

INDEPENDENCE, MO.—The Independence Water Works Co. writes us that the reported improvements got out through the controversy in reference to the city buying the plant, and that no new work is projected at present.

WESTPORT, MO.—It is reported that an election will soon be held to vote on an issue of bonds for works.

WACO, TEX.—The plant of the Waco Water & Light Co., on which there is a mortgage of $416,000 has been ordered sold by the court.

LINCOLN, CAL.—A press report states that $20,000 in bonds have been voted for works, the water supply to be by gravity from an elevation of 200 ft. above the town.

SAN LUIS OBISPO, CAL.—Bids are asked until Jan. 6 for the purcharse of $90,000 of water bonds and $34,500 of sewer bonds. C. F. Sammann, Cy. Clk.

CLEVELAND, O.—Bids are asked until Jan. 18 for furnishing about 24,000 ft. of 42 to 16-in. cast-iron pipe, and 320 6 and 4-in. fire hydrants. M. W. Kingsley, Supt. W. W.; D. E. Wright, Dir. Pub. Wks.

SMITHVILLE, TEX.—Plans and bids are asked for water-works and a electric light plant. M. Burleson, Secy., Smithville Town Co.

POMONA, CAL.—Bids are asked until Jan. 21 for constructing works, as described in our advertising columns. This is a postponement of date from Jan. 15, as advertised last week. W. H. Sanders, Cy. Engr.; J. R. Gartnside, Cy. Clk.

MOUNT FOREST, ONT.—Plans and bids are asked until Jan. 10 for constructing a system; deposit $5,000. W. G. Scott, Chm. Com.

BALTIMORE, MD.—Bids are asked until Jan. 6 for 2,000 tons of cast-iron pipe, and other supplies, as noted in our advertising columns. Wm. L. Kenly, Acting Ch. Engr.

GREENVILLE, MISS.—The contract for constructing works, as advertised in Engineering News, has been awarded to G. Jaeger, of Rich Hill, Mo., at $58,523. Some of the prices will probably be published next week.

CINCINNATI, O.—John W. Hill and Samuel Whinery, of Cincinnati, and Geo. H. Benzenberg, of Milwaukee, have been appointed a committee by the board of administration to investigate the water-works system of this city and report on the question of improvements and an improved water supply. A. P. Butterfield, Clk. Bd.

IRRIGATION.

ANTONITO, COLO.—Bids are asked until Jan. 21 for sinking an artesian well at this place. Bids were received Dec. 16 for this work, but were all rejected by the board of construction. F. Cogswell, Deputy State Engr., Denver; H. A. Sumner, State Engr., Denver.

NEW COMPANIES.—California Finance Co., New York, N. Y.; $25,000; to investigate and promote irrigation investments in California, to buy and sell water rights, etc. Stanley W. Dexter, William Church Osborn, William B. Burns.

SEWERAGE.

EXETER, N. H.—It is reported that the county commissioners are contemplating an improvement to the sewer at the county farm. About 12,000 gals. of sewage empty into a brook near the buildings. It is proposed to allow the sewage to go into a vat which will hold all the heavy matter that can be used for fertilizing, while the water will run off the top of the vat.

BOSTON, MASS.—Bids are asked until Dec. 27 for about 2,240 ft. of 24 to 10-in. pipe sewers in Blue Hill Ave. B. T Wheeler, Supt. Sts.; Henry B. Wood, Engr. We are informed that the superintendent of streets received the following bids Dec. 21 for constructing a sewer in Columbus Ave., all the bidders being residents of Boston: P. O'Connell, $8,773 (awarded contract); Quimby & Ferguson, $9,909; J. Dolan, $10,838; H. P. Nawn, $11,292; Collins & Ham, $11,275; Metropolitan Construction Co., $13,905; Jones & Meehan, $18,894.

HYDE PARK, MASS.—At a recent town meeting it was voted to appropriate $1,000, in addition to the $500 already allowed, for completing surveys, plans, etc., for the proposed system. It is proposed to have the sewers connect with the Neponset Valley system. F. W. Darling is on the committee.

GARDNER, MASS.—The town has voted to issue $9,000 in bonds for completing the Woodland Ave. sewer. C. W. Conant is a member of the committee.

LYNN, MASS.—Chas. W. Gay, Cy. Engr., writes us that the Shone Co., of Illinois has contracted at $6,625 to furnish the city the following plant and to guarantee its perfect and continuous operation for six months after completion and erection: Two pneumatic ejectors of 200 gallons per minute capacity with cast-iron chamber to receive them; two air compressors and two electric motors of sufficient capacity to work the ejectors; one air receiver with necessary piping to the ejectors; 30 ft. of discharge pipe connecting with effluent sewer. The city is to furnish required housing.

TAUNTON, MASS.—The sewer committee of the council is considering the question of having plans prepared for a trunk sewer system to be built in the spring.

WESTBORO, MASS.—Geo. S. Adams, Supt. State Lunatic Asylum, Westboro, writes us that an appropriation will be asked of the legislature for an additional plant for disposing of the sewage of the Westboro insane hospital. If the appropriation is granted, plans will be made in accordance with the wishes of the state board of health.

PROVIDENCE, R. I.—It is stated that the sewer committee has recommended that the commissioner of public works be directed to construct the West River branch sewers, to cost about $500,000.

BROOKLYN, N. Y.—Bids are asked until Jan. 7 for constructing sewers in two districts. Alfred T. White, Comr. Cy. Wks.

ROCHESTER, N. Y.—The East Side sewer commission has voted to construct the Mount Hope overflow storm sewer, to empty into the river at Gregory St. The sewer will be 1,425 ft. long and is estimated to cost $12,000. John Y. McClintock, Cy. Engr.

SHARON SPRINGS, N. Y.—The construction of a sewer system is being considered, according to reports.

NEWTON, N. J.—It is stated that the council has voted to advertise for bids for constructing sewers in a number of streets.

CHESTER, PA.—It is probable that in the spring council will order the construction of the proposed Edgmont Ave. sewer. Address S. Greenwood.

YEADON, PA.—Albert Moore, Clk., writes us that the borough surveyor is now taking soundings over the route for the sewer system. The report is to be ready for a town meeting to be held Jan. 15.

COLUMBUS, O.—The council is considering the question of constructing sewage disposal beds.

DECATUR, ILL.—The council is considering the question of extending the Broadway sewer 5,100 ft., at an estimated cost of about $52,000.

MONMOUTH, ILL.—The construction of additional sewers and of a better sewage disposal system than is now in use is being considered.

KANSAS CITY, KAN.—Bids will be received about Jan. 6 for constructing about 4,000 ft. of sewers, at an estimated cost of $20,000. C. A. Ellis, Cy. Engr.

ST. LOUIS, MO.—Bids are asked until Jan. 7 for constructing 15 and 12 in. pipe sewers. Robt. E. McMath, Pres. Bd. Pub. Improvements.

TEMPLE, TEX.—The Temple Sewer Co. has been incorporated, with a capital stock of $4,000, by Wm. D. Cox, F. A. Venney and R. L. Hollingsworth.

NYACK, N. Y.—Bids are asked until Jan. 24 for furnishing materials and constructing a sewer system, as described in our advertising columns. Edward H. Cole, Clk. Comrs.; Jas. S. Haring, Engr.

LOUISVILLE, KY.—Bids asked until Jan. 3 for furnishing sewer brick, pipe and other supplies during 1896. J. Henry Hoertz, Secy. Bd. Pub. Wks.

GARBAGE DISPOSAL.

WILLIMANTIC, CONN.—It is reported that steps are being taken to establish a system for the removal of garbage from the thickly-settled portion of the city.

BROOKLYN, N. Y.—Bids are asked until Dec. 31 for the collection and removal of garbage from Ward 32 (town of Flatlands) during 1896. A. T. White, Comr. Cy. Wks.

SYRACUSE, N. Y.—Bids are asked until Dec. 30 for furnishing materials and destroying the garbage of the city, bids to be with and without collecting. Henry C. Allen, Cy. Engr.; H. F. Stephens, Cy. Clk.

ST. PAUL, MINN.—The council has passed a resolution appropriating $20,000 for a garbage crematory. It has just received 13 bids, ranging from $9,700 to $19,000, for garbage collection next year.

STREETS AND ROADS.

BOSTON, MASS.—Bids are asked until Jan. 3 by the Metropolitan Park Commission for building a driveway over two miles long for the Mystic Valley Parkway. The work will consist of 80,000 cu. yds. earth grading; 5,000 cu. yds. filling material, to be furnished by the contractor; 2,400 lin. ft. of 8-in. drain, 1,600 lin. ft. of 10-in. drain, 50 lin. ft. of 12 in. drain; 100 cu. yds. of brick masonry; 200 cu. yds. of rubble masonry laid dry; 800 lin. ft. of circular edgestone; 3,500 sq. yds. of gravel-walk surfacing, and 16,700 sq. yds. of loam surfacing. Engr., Wm. T. Pierce, 13 Exchange St.

CAMBRIDGE, MASS.—The following bids have been received by L. M. Hastings, Cy. Engr., for excavating and grading highways at Hobbs Brook storage basin: Jos. D. Gennaro, Boston, Mass., Section C, $41,977.50; Section D, $41,781.25; Wm. H. Mague, West Newton, Mass., C, $53,495; D, $64,750; Newell & Snowling, Uxbridge, Mass., C, $45,525; D, $47,250; August Saucier, South Framingham, Mass., C, $40,814.50; D, $42,000; Frank X. Saucier, Boston, Mass., C, $45,180; D, $47,250; Wm. T. Ross, Waltham, Mass., C, $56,666; Craib and Trumbull, Winthrop, Mass., D, $61,250; David Hall, Boston, Mass., C, $48,935. Michael Leahy, Southboro, Mass., D, $49,000.

WILLIMANTIC, CONN.—H. D. Card, Engr., Willimantic, informs us that the following bids were received, Dec. 12, for building a telford macadam road in Sprague: B. D. Pierce, Jr., Co., Bridgeport, Conn., $1.13 per sq. yd.; Bridgeport Stone Road Construction Co., Bridgeport, Conn., $1.07; Amede Belair, Baltic, Conn., $1.02 (awarded contract).

ALBANY, N. Y.—Bids are asked until Jan. 6 for granite block paving in Fourth Ave., and brick paving in Swan St.; four sureties of $5,000 each. Thos. J. Lanahan, Clk. Bd. Contract.

CORTLAND, N. Y.—We are informed that the construction of pavements and sewer extensions is being discussed.

SYRACUSE, N. Y.—The following bids have been received for paving in South Clinton St.: With asphalt—Asphalt Paving Co., John Dunfee, $23,077; L. B. Moore, $27,954; Burmudez Asphalt Paving Co., $23,722; Syracuse Improvement Co., $26,732; Warren-Scharf Asphalt Paving Co., $24,000; G. D. Grannis, $26,187. With sandstone block—Homer & Co., $37,005; G. D. Grannis, $39,755. With brick, Arthur J. Keeffe, $27,007; Homer & Co., $26,005; J. E. Miles & Co., $27,660.

EAST ORANGE, N. J.—The park commission is considering plans for the driveways for the proposed park system, estimated to cost about $50,000. Henry H. Hall, Wm. M. Franklin, Frank Q. Barston and Joel F. Freeman are interested.

EASTON, PA.—We are informed that an ordinance has been introduced in the council providing for an increase of $100,000 to the indebtedness of the city and the submission of the question to the electors to be voted on at the next municipal election. The money is to be used for permanent street improvement. H. R. Fehr, Cy. Engr.

HARRISBURG, PA.—An underground passageway will be built under the tracks of the Pennsylvania R. R., at Herr St. Select Counilman Fitzgerald, Chn. Com.

DANVILLE, VA.—It is likely that about 40,000 sq. yds. of streets will be repaved next year. C. A. Ballou, Cy. Engr.

CANTON, O.—It is stated that the park commissioners will soon ask for bids for grading, etc., in connection with Cook Park. H. G. Shauls, Cy. Clk.

CINCINNATI, O.—Bids are asked until Jan. 14 for grading and brick paving in Golden Ave. Aug. Herrmann, Pres. Bd. Administration.

WYOMING, O.—Bids are asked until Jan. 3 for grading and macadamizing the Oliver Road. W. A. Clark, Village Clk.

TERRE HAUTE, IND.—Bids are asked until Jan. 7 for improving 17th St. Chas. H. Goodwin, Cy. Clk.

DETROIT, MICH.—The Lakeside Boulevard Co., 140 First St., has been incorporated to build a boulevard in this city; capital stock, $10,000; Pres., Geo. Hendrie; Treas., E. C. Skinner.

LANSING, MICH.—Jasper C. Davis, Cy. Engr., writes us that a petition is now being circulated for paving Washington Ave. It is probable that when it is presented to the council, plans, etc., will be ordered for the work, which will probably cost about $100,000.

EAST ST. LOUIS, ILL.—Bids are asked until Jan. 15 for grading, paving and sewers in Illinois Ave. H. F. Banier, Mayor; L. L. Harper, Cy. Engr.

LA CROSSE, WIS.—The committee is considering the question of brick paving.

SIOUX CITY, IA.—The question of brick paving is under discussion.

FORT SMITH, ARK.—It is reported that about 7,300 sq. yds. of brick will be laid in North St. James B. Gass, Cy. Engr.

SAN FRANCISCO, CAL.—J. J. McEwen, 118 Montgomery St., San Francisco, writes us as follows concerning the projected Folsom St. improvement, noted in our issue of Nov. 21: It is proposed to make the street a fine driveway by paving it with bituminous rock, on a concrete base. The street is about three miles long and 82½ ft. wide, and runs through the most populous section of the city, and if completed will connect with the adjacent country and interior. At present the matter is in an indefinite state, and is simply being agitated and urged. The project is awaiting the decision of the board of supervisors. If the work is undertaken the contract will be let by the Supervisors and the work carried on under the supervision of the superintendent of streets.

NIAGARA FALLS, N. Y.—Bids are asked until Jan. 10 for 19,300 sq yds. of asphalt paving, as stated in our advertising columns. W.W. Read, Cy. Engr.; J. F. Arkush, Cy. Clk.

MANUFACTURING PLANTS.

MANCHESTER DEPOT, VT.—A report states the Dorset Mountain Marble Co is talking of erecting a mill and finishing shop that will employ about 450 men.

SOUTH HADLEY FALLS, MASS.—The Caren Mfg. Co. writes that it does not contemplate any immediate addition to its plant, as reported.

WOONSOCKET, R. I.—It is stated that the Woonsocket Napping Co. is building a wooden mill 125 × 26 ft., to be used in the manufacture of a shearing machine, for use in woolen mills.

CENTERVILLE, R. I.—It is reported that a mill will be erected at this place, to be 100 × 400 ft., with engine house, picker house, and storehouse, adjacent. A 750-HP. cross-compound, condensing engine will probably be used. Address H. Lawton.

AMSTERDAM, N. Y.—A news item states that T. R. Brown & Co., are planning to move their plant to Fort Hunter. They will require a 30-HP. boiler, preferably an upright, and a 25-HP. engine.

BUFFALO, N. Y.—It is announced that a factory for producing liquid chemicals is to be established here, and that Frederick Overberg and Henry Bluenberg, of New York, have contracted with the Niagara Falls Power Co. for 500 HP., with the privilege of more. It is understood that two structures will be erected, 125 × 160 ft.

CORTLAND, N. Y.—Cooper Bros. write us that no steps have yet been taken in regard to rebuilding their plant, as noted in our issue of Dec. 12.

NEW YORK, N. Y.—George J. Buttman is said to be about to erect a three-story brick factory, northeast corner of 142d St. and Washington Ave., to cost $25,000.

JOHNSTOWN, PA.—The Cochran Co., manufacturers of ice and refrigerating machines, has leased buildings for its manufactory and contracts have been awarded for all machinery, etc.

BOONTON, N. J.—A news item states that at a recent meeting of the board of trade, a communication was read from the Atwood Machine Co. in relation to locating a business enterprise that will give employment to from 200 to 300 hands, and from a Mr. Churchwood, of Brooklyn, seeking a site for an electric dynamo factory. Address C. A. Norris.

TRENTON, N. J.—It is stated that a three-story brick brewery addition is to be built for Franz Hills on Olden Ave. Arch., Herman Voight, Philadelphia.

FRANKLIN, PA.—Press report states that the Eclipse Oil Works are to be enlarged and improved at a cost of $250,000.

PHILADELPHIA, PA.—It is stated that Innes Bros. will erect an engine and boiler house on Boudinot and Somerset Sts.

PITTSBURG, PA.—The Pennsylvania Lubricating Co., is reported about to erect an ironclad building, one-story high in addition to its present plant on 34th St.

WASHINGTON, PA.—Samuel F. Patterson, of Pittsburg, informs us that two companies are being organized to manufacture steel specialties at this place, as noted in our columns on Nov. 21, but that the plans are not yet completed.

TOWANDA, PA.—The roller process flouring mill of G. A. Dayton, of Towanda, has been damaged by fire to the extent of $50,000, according to press reports; insurance, $28,000.

HAGERSTOWN, MD.—It is understood that the Mining & Land Improvement Co. has offered S. H. Weyhenmeyer the choice of three lots for his proposed knitting mill, and has given the Raynar Silk Throwing Works and the Graf Tannery encouragement to locate at Hagerstown, and it is probable that these industries have been secured.

ALEXANDRIA, VA.—C. C. Smoot & Son Co. write us that nothing will be done until next fall in regard to erecting buildings for their leather manufactory.

BURLINGTON, N. C.—The Southern Ry. Co. has decided to establish new machine shops at this place, on account of the opening next month of the new route to Norfolk, Va., which becomes the deep-water terminus of the system after January, and machinery is now being placed in the shops. The buildings (with the exception of a round house, which will be built) are already at hand, the shops of the North Carolina R. R. having been located at this point prior to the lease of the road to the old Richmond & Danville system, and discontinued by the lessee. About 100 employees will be put to work. T. S. Inge, of Raleigh, has been appointed master mechanic of the shops, and has already taken charge.

LEAKSVILLE, N. C.—W. R. Walker, E. B. Burke and others are organizing a company to build another cotton mill at this place.

TAYLORSVILLE, N. C.—W. L. Alexaugh and associates will build a cotton mill at this place at an early date, work to begin probably next spring.

CLINTON, S. C.—M. S. Bailey is at the head of a

company which proposes to build another cotton mill at this place of about 10-000-spindle capacity.

ATHENS, O.—It is reported that Legior, Barlow & Co. are asking the council for a site on which to erect a factory to employ 200 hands.

CLEVELAND, O.—According to press reports the Cleveland Steel Co., J. A. Potter, Man., will soon begin the erection of an addition, 40 × 300 ft., to be of steel.

CLEVELAND, O.—A news item states that a mill for manufacturing steel railway ties may be built in this city, to cost $3,000,000. A. J. Hartford, of New York, the inventor of the tie and president of the New York & Chicago Ry. Improvement Co., is interested, and is reported as saying that a location will be selected within three weeks. The Improvement Co. is reported as at present manufacturing the ties for the New York Central R. R. Co.

TOLEDO, O.—William Peter will, according to reports, increase his present plant to double his output of bicycles, with the possibility of a further increase next May.

ANDERSON, IND.—It is reported that the Gedge Bros. Iron Roofing Co. will erect an addition to its plant.

INDIANAPOLIS, IND.—Charles F. Smith, Alfred B. Gates, Joseph P. Tedron and others have purchased a site upon which they will erect a bicycle factory, to cost $1,000,000, according to press reports. The company is known as the Albany Mfg. Co.

ADRIAN, MICH.—The Bond Steel Fence Post Co. writes us that the contract for erecting its plant, as noted in our issue of Dec. 5, has been let. The company will purchase a 60-HP. engine and an 80-HP. boiler.

BALDWIN, MICH.—The Baldwin Milling Co.'s mill, elevator and other buildings have been destroyed by fire; reported loss, $25,000; insurance, $12,000.

CHICAGO, ILL.—It is reported that the Ogden Gas Co. has succeeded in floating from $2,000,000 to $3,000,000 of its securities, and will ask the city authorities for a permit to begin construction work. Address John W. Lanehart.

MOLINE, ILL.—Press report states that J. A. P. Berg is organizing a $10,000 stock company to manufacture a combination heater; factory to be located at East Moline.

MONMOUTH, ILL.—The Weir Plow Co.'s plant was recently destroyed by fire; reported loss, $150,000, fully covered by insurance.

MILWAUKEE, WIS.—The National Envelope Co. has secured a site for the erection of a new building, which is to be six stories; estimated cost, $50,000.

ST. PAUL, MINN.—Press reports state that an ordinance has been passed granting the St. Croix Lumber Co. the lease of four lots just east of the Waterous Engine Works Co.'s plant, on which to construct a sash, door and blind factory, 40 × 120 ft.; also to George Foley for the lease of a tract of land on the upper levee for the establishment of a factory for the manufacture of brick and cement.

CHEYENNE, WYO.—We are informed that the Carey Co., composed mostly of Philadelphia capitalists, has just completed a three-story brick and stone building in Cheyenne, and the rumor is that the same company is back of a projected iron plant, to be started here in the near future.

MINCO, IND. T.—It is stated that the Minco mill and elevator was recently burned; reported loss, $38,000; insurance, $15,000. Will probably be rebuilt.

SAN BERNARDINO, CAL.—It is reported that Mr. Hubbel is at the head of an enterprise to establish a plant for the manufacture of harrow cultivators in this city.

WINNIPEG, MAN.—Press reports state that E. F. Hutchings has decided to build a large warehouse and manufacturing establishment on the transfer spur track, near Ashdown's new warehouse, next spring. The structure will be 50 × 125 ft., six stories high, of brick and stone.

SHERBROOKE, QUE.—This city is reported to have offered the Gardner Tools' Works Co., of Brockville, Ont., $5,000 and 20 years' exemption from taxes to remove to this place; the works employ about 70 hands.

LONDON, ONT.—The agreement between the city and Grand Trunk Ry. for the erection of the company's shops in East London was ratified by the council at a recent meeting.

MISCELLANEOUS CONTRACTS.

JETTY EXTENSION, ETC.—New Orleans, La.—Bids are asked until Jan. 23 for extension of east jetty for improving mouth and passes of Calcasieu River, La. Maj. James B. Quinn, U. S. Engrs., 347 Carondelet St.

PARK WORK.—New York, N. Y.—Bids are asked by the department of public parks until Jan. 6 for about 11,000 cu. yds. of excavation and 9,500 cu. yds. of filling in Mulberry Bend Park.

CARS AND LOCOMOTIVES.—It is stated that railways will probably be in the market in February or March for cars and engines, as follows:

	Cars.	Engines.
Lake Shore	3,000	12
Pennsylvania	4, 00	40
Pennsylvania lines	3,500	30
Wabash	3,000	20
Lake Erie & Western	2.000	25
Pittsburg & Lake Erie	1,000	8
New York Central	3,000	25
Other Eastern roads	10 000	150
Western lines	20,000	240
Total	49,500	570

PUMPING STATION, New Orleans, La.—Bids are asked until Feb. 11 for the erection of a pumping station, including machinery, etc., as stated in our advertising columns. Frank Marquez, Secy. Comrs. Orleans Levee District.

CONTRACT PRICES.

BOILERS.—Newport, Ky.—John Surran, Supt. W. W., writes us that the contract for a battery of two boilers, 72 ins. diameter of shells, each boiler to have 26 6-in. tubes, 20 ft. long, riveted to heads, has been awarded to the Fulton Boiler Works, the bids being as follows:

McElvaine & Spiegal, Cincinnati, O	$3,495
Chandler & Taylor, Indianapolis, Ind	3,496
Johnson Galbreth, Cincinnati, O	3,445
Robert Jones & Co., Cincinnati, O	3,6 5
Fulton Boiler Works, Richmond, Ind	3,368

TILE SEWERS.—Erie, Pa.—Bids for constructing tile sewers were opened by Geo. Platt, Cy. Engr., Dec. 19, and contracts awarded as follows: J. McCormick & Son, Erie, 15-in. sewer, average cut 14.23 ft., 608 ft., 82 a ft.; 15-in. branch, 70 ft., $2 10; 9-in. pipe, 75 ft., 40 cts.; 6-in., 540 ft., 30 cts.; manholes, 3, $40 each; catch basins, 3, $30 each. D. O'Brien, Erie, 12-in. sewer, average cut 13.2 ft., 214 ft., 98 cts. a ft.; 12-in. curves, 50 cts.; 12-in. branches, 22 ft., 81.50; 9-in. pipe, 20 fr., 35 cts.; 6-in. pipe, 144 ft., 30 cts.; manholes, 1, $32; catch basins, 1, $28.

LEVEE WORK.—New Orleans, La.—The following contracts are reported to have been awarded by Capt. Derby Dec. 12: Lower Tensas levee district, Palo Alto levee, about 30,700 cu. yds., to H. M. McLaughlin, New Orleans, at 11 cts. a cu. yd.; Barataria levee district, Star levee, 18,400 cu. yds., to W. H. Harris, New Orleans, 13½ cts.; Ironton to Myrtle Grove levee, 9,900 cu. yds., to Simon Leopold, Phœnix, La., 11 cts.; Myrtle Grove to Woodpark levee, 10,800 cu. yds., to John Cleary, New Orleans, 11.89 cts.; Woodpark to Deer Range levee, 14,100 cu. yds., to W. H. Harris, New Orleans, 12½ cts.; Deer Range to Junior levee, 16,900 cu. yds., to W. H. Harris, 12.45 cts; Junior to Point Celeste levee, 11,000 cu. yds., W. H. Harris, 13 cts.

PILING.—St. Louis, Mo.—J. R. Bollinger, Ch. Clk., office of Col. Chas. R. Suter, U. S. Engrs., writes us that the following bids were received Dec. 11, for 62,528 ft. of long leaf yellow piling, 1,598 piles:

Bidder.	Per lin. ft.	Total.
Jacob Salmen, Slidell, Miss	$0.185	$11,568
C. L. Chaffee, Omaha, Neb	.142	8,886
Berthold & Jennings, St. Louis, Mo	.1668	10,430
St. Louis Refrigerator & Wooden Gutter Co., St. Louis, Mo	.1674	10,457
E. E. Moberly, Chicago, Ill	.22⅛	13,9 1
Chas. R. Robinson, Meridian, Miss	.175	10,922

METAL MARKET PRICES.

LEAD.—New York: 3.15 to 3.22 cts. Chicago: 2.95 to 3 cts. St. Louis: 2.97 to 3 cts.

BARB WIRE.—Pittsburg: $1.95 to $2 for galvanized, and $1.90 to $1.95 for painted in carload and less than carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $13 to $14. Pittsburg: $12.75 to $13.75. Chicago: $13 to $15.50.

TRACK MATERIAL.—New York: angle bars, 1.45 to 1.55 cts.; spikes, 1.75 to 1.85 cts.; track bolts, 2 to 2.1 cts. with square, and 2.1 to 2.2 cts. with hexagon nuts. Chicago: angle bars, 1.65 to 1.8 cts.; spikes, 1.85 to 1.9 cts.; track bolts, 2.25 to 2.3 cts. with square and 2.45 to 2.5 cts. with hexagon nuts.

NAILS.—Pittsburg; $2.25 per keg for carload lots and $2.25 for less than carload lots, at mill; $2 and $2.05 for cut nails at mill. Chicago: $2.40 and $2.50 for wire nails, $2.17 and $2.25 for cut nails. New York: $2.43 and $2.53 for wire nails, and $2.18 and $2.30 for cut nails.

RAILS.—New York: $28 at eastern mills and $28.75 at tidewater; old rails, $14.50 to $15 for iron, and $12.50 for steel; light rails, $29; girder rails, $26. Pittsburg: $28 for standard sections of 45 lbs. and over; old rails, $16 50 for iron, and $14.50 for steel. Chicago: $29 to $31 for standard sections, $28 for light sections; old rails, $15.50 to $16 for iron, and $11.50 to $12.25 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.68 to 1.75 cts.; channels, 1.7 to 1.8 cts.; angles, 1.55 to 1.6 cts.; tees, 1.75 to 1.8 cts.; universal mill plates, 1.6 to 1.65 cts., steel plates, 1.5 to 1.6 cts.; for tank, 1.65 to 1.75 cts. for shell, 1.75 to 1.9 cts. for flange, 2.1 to 2.25 cts. for ordinary firebox, 2.25 to 2.5 cts. for locomotive firebox. Pittsburg: beams, 1.5 to 1.55 cts.; channels, 1.5 to 1.55 cts.; angles, 1.35 to 1.4 cts.; tees, 1.5 cts.; Z-bars, 1.5 cts.; universal mill plates, 1.5 to 1.6 cts; steel plates, 1.5 to 1.55 cts. for tank, 1.6 to 1.65 cts. for shell, 1.7 to 1 75 cts. for flange, 2.5 cts. for ordinary firebox, 2.5 to 3.5 cts. for locomotive firebox. Chicago: beams, 1 7 to 1.8 cts.; channels, 1.7 to 1.8 cts.; angles, 1.55 to 1.65 cts.; tees, 1.8 to 1.9 cts.; universal plates, 1.6 to 1.7 cts.; steel plates, 1.65 to 1.7 cts. for tank, 1.8 to 1.9 cts. for flange, 2.25 to 2.5 for ordinary firebox, 4 to 4.5 cts. for locomotive firebox.

SCRAP.—In scrap iron, hammered car axles are quoted at $18 to $18.50 at New York; car wheels, $11 to $12; cast borings, $7 to $8; wrought turnings, $9 to $9.50; burnt iron, $6.50 to $7; all delivered to purchaser; No. 1 wrought scrap, $12.50 on cars; cast machinery, $10 to $11 at mill; wrought pipe and tube, $7.50 to $8 delivered at New York.

INDUSTRIAL NOTES.

MR JOSEPH HALSTED, of Chicago, Ill., has formed a partnership with his brother under the firm name of Halsted Bros., and the new firm has bought the boiler works of Lloyd & Pennington, of this city.

McCOOL & REEVES, of Pittsburg, Pa., have purchased the Beaver Falls Cutlery Works, and will fit the plant for the manufacture of steel tubing.

THE BOSTON BRIDGE WORKS, of Boston, Mass., has received the contract for several plate girder bridges for overhead crossings at points along the line of the Old Colony Railroad, near Brockton.

THE HARRISBURG FOUNDRY MACHINE CO., of Harrisburg, Pa., recently received an order its engines for an electrical plant in South Africa

THE DELAWARE IRON WORKS, of New Castle, Del., has received an order for 600 iron telegraph poles to be used at Cairo, Egypt.

THE PHŒNIX ELECTRICAL SUPPLY CO., of Pittsburg, Pa., has closed a contract with the New York State Electrical Co., of Youngstown, O., to do the work carried on by the latter company.

JAMES H. CRANDALL, 626 and 627 Mining Exchange, Denver, Colo., has associated with him Messrs. Charles L. and William H. Huff, under the firm name of Crandall & Huff. The new firm will continue the business of dealing in railway, mining and manufacturers' supplies, and will also deal in mining investments and will buy, sell and trade in mining stocks.

MEEHAN BROS., of New Castle, Pa., have placed the manufacture of their new type of boiler with the James P. Witherow Co. The improvement, in part, consists in a system of tubes, through which any dirt which may collect in the boiler is forced into the mud drum.

JONES & LAUGHLINS, of Pittsburg, Pa., are contemplating making further improvements to their plant by increasing the Bessemer vessels in their converting from eight to ten tons capacity, and erecting a new blooming mill. The firm will also make its own ingot molds, and a building for this purpose is to be erected.

THE YOUNGSTOWN BRIDGE CO., Youngstown, O., is completing a number of bridges for the C. A. & C. R. R.; the L. S. & M. S. R. R., the M. & C. R. R. and the C. P. & V. R. R. The company recently contracted for a riveited lattice span for the B. & O. R. R., girder work for the A. C. & I. R. R. and three bridges for the C. & M. R.R. in Baltimore. Among other work is three spans for Mobile, Ala., the Weir passes for the movable dams on the Great Kanawha River, and the structural work for a smelting plant at Lordsburg, New Mexico.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., have received the contract for erecting the new dye house of the Alexander Smith & Sour Carpet Co., of Yonkers, N. Y., to be 60 × 172 ft., the steel roof trusses being arranged to carry cars on the lower chord for moving material about the building.

THE HALL SIGNAL CO., of New York city, is reported as having a contract to equip 186 miles of the Lehigh Valley R. R. with automatic signals.

THE KENILWORTH BRICK WORKS, at East Liverpool, O., were recently sold to the Park Fire Clay Co., of Pittsburg, Pa. It is stated that the works will be started as soon as they can be put in running order, giving employment to over 200 men.

THE GLOBE IRON WORKS, of Cleveland, O., have been awarded contracts for two new steel steamers for the ore trade.

THE WATEROUS ENGINE WORKS CO. have nearly completed its plant at Brantford, Ont. The main building is 300 × 120 ft., and has a central space 40 ft. wide extending to the roof, over which a traveling crane will be operated. The foundry is 80 × 100 ft.; blacksmith shop, 80 × 50 ft., boiler shop 120 × 87 ft., and the power house 60 × 40 ft., in which a 250 HP. engine will be located.

THE H. H. SCOVILLE CO., of Chicago, Ill., has received contracts for two 20-stamp mills, one to be built in Utah and the other in Colorado. The company is also building hoisting engines and other mining machinery for several United States mines and is estimating on stamp mills for Colombia and Nicaragua.

THE RAILWAY CYCLE MFG. CO., of Hagerstown, Ind., has received orders for six of its double cars to go to Moscow, Russia. This will make a total of 14 of these cars shipped to Russia.

THE DUNKIRK ENGINEERING CO., of Dunkirk, N. Y., has made an assignment to Henry Reynolds, of Sinclairville, N. Y.

THE LODGE & DAVIS CO., of Cincinnati, O., is making a machine for bicycle manufacturers which cuts and finishes bicycle hubs from a bar of steel in one operation.

THE PITTSBURG CLAY MFG. CO., of Pittsburg, Pa., has shut down its sewer-pipe works at New

Brighton for an indefinite period, according to reports.

THE AMERICAN BALANCE SLIDE VALVE CO., of San Francisco, has had good success in introducing its valves, and reports that they have been placed upon more than 1,400 locomotives and 300 stationary engines. These valves are adaptable also to marine engines. The form of balance used permits of adaptation to any degree of balancing desired, from the smallest stationary engine requiring a 4½-in ring, up to a marine engine with a balancing area of 453 sq. ins., which requires two rings, each 17 ins. in diameter.

THE SCHENECTADY LOCOMOTIVE WORKS, Schenectady, N. Y., is reported as negotiating for an arrangement whereby it will co-operate with the General Electric Co. in the manufacture of electric locomotives. The locomotive works recently turned out the frame for the three large electric locomotives which the General Electric Co. has built for the Baltimore & Ohio R. R.

THE BARFIELD CAR COUPLER CO., of Chattanooga, Tenn., has been incorporated by H. Clay Evans, Geo. W. Barfield and others. Mr. Barfield is the inventor of the coupler to be made and is Chief Car Inspector at Chattanooga, for the Southern Ry.

WM. CLENDINNING & SON, iron founders, of Montreal, Que., are asking for tenders; through their agents, Kent & Turcotte, 97 St. James St., Montreal; for the purchase of the foundry buildings, plant, etc., at St. Henri, covering about 350,000 sq. ft. of ground, comprising stove foundry, 300 × 60 ft., pipe foundry, machinery and jobbing foundry, machine shop, nickel-plating shop and pattern shop. These works are on the Lachine Canal and near the Grand Trunk Ry.

THE CONSOLIDATED ROLLING STOCK CO., of Toledo, O., has an order for 200 cars from the Pittsburg & Lake Erie Ry. It is stated that this company is now building cars for nineteen different railroads.

THE WALTER A. WOOD MACHINE CO., of Hoosic Falls, N. Y., have had Danforth Geer and Seymour Van Santvoord appointed receivers upon application of the trustees. It is stated that the works are likely to be started next month and that the recently formulated plan of re-organization will be carried out.

THE COFRODE & SAYLOR CO., of Philadelphia, Pa., known also as the Philadelphia Bridge Works, will resume operations under its own management at an early date, Judge Pennypacker, of Court No. 2, having made a decree authorizing the receiver to turn over the property to the company.

THE COLUMBIA CONSTRUCTION CO., of Chicago, Ill., has announced, according to the "Times-Herald," that it will give to the subscribers for its last $3,000,000 of capital stock, when the latter is fully paid in, Union Elevated Railroad stock to the extent of 15% of their holdings in the Columbia Construction Co. The Union Elevated R. R. has an authorized bond issue of $5,000,000, and an equal amount of stock. Three million dollars of bond will shortly be floated to pay for the construction of the loop.

JOHN MOHR & SONS, Chicago, are building a new boiler manufacturing plant at South Chicago, to be 120 × 330 ft., of steel construction throughout and 12-in. brick walls. W. Morava, Agt. Shiffler Bridge Co., 65 Dexter Bldg., Chicago, has the contract for the iron work. It is stated that this will be the largest boiler works in the West when completed.

THE NEW CASTLE STEEL SEWER PIPE CO., of New Castle, Ind., has been formed with a capital stock of $10,000. Plans will be made at once for a building 40 × 60 ft. and the contract for erecting same will be awarded at an early date. T. J. Burk, Eugene Runyan and others are interested.

THE POCAHONTAS CO., of Roanoke, Va., has contracted to furnish the Illinois Steel Co., with 500,000 tons of coke.

THE CANTON STEEL ROOFING CO., Canton, O., has recently been awarded contracts for the roofing for the government post office building at Washington, D. C. This company is having large demand for heavy gage galvanized conductor pipe, which it makes of Nos. 18 to 28 gage galvanized sheets.

THE GRIFFIN WHEEL CO., Chicago, Ill., has increased its capital stock from $1,000,000 to $1,250,000. The company has large foundries at Chicago and Detroit, and within the present year has built and started a foundry at Denver, and has just purchased the Northwestern Wheel & Foundry Co.'s Works, at St. Paul. It is stated that the combined output of these four establishments will be about 450,000 car wheels per annum.

THE DEANE STEAM PUMP CO., of Holyoke, Mass., has been awarded first premium for its collection of pumping machinery on exhibition at the Chilean Exposition of Mines and Metallurgy, held at Santiago, Chile. The Deane Co. had several of its latest designed mine pumps in operation, they being operated both by steam and electricity.

THE AULTMAN & TAYLOR MACHINERY CO., of Mansfield, O., has sold Cahall vertical water tube boilers of 300 HP. to the Mahoning Valley Iron Co., of Youngstown, O., and of 500 HP. to the Shoenberger Steel Co., of Pittsburg, Pa. All these are for utilizing the heat of furnace gases. The sales were made through H. E. Collins & Co., of Pittsburg.

MOHN & HOFF, of 153 La Salle St., Chicago, Ill. finding it desirable to enlarge their business announce in a circular letter that the firm has been dissolved and that Messrs. J. Hakon Hoff, Richard Mohn and Warren R Roberts have organized and incorporated the H. M. R. Construction Co., as successors, to do a civil engineering and contracting business in steel and iron construction.

CURRAN & HUSSEY, 347 Fifth ave., Pittsburg, Pa., have closed a contract for an irrigation plant, including pipe line of some 23 miles in length in Southern California and are about to open a branch office at Oceanside, Cal.

CATTLE GUARDS.—Mr. Frank C. Balch, who has heretofore been manager of the Bush Cattle Guard Co., of Kalamazoo, Mich., has purchased the controlling interest in this company. Mr. Balch reports several recent orders for cattle guards from South America, and states that the Bush guard is now used on 43 railroads.

HOUSE MOVING.—H. Sheeler, 83 Washington St., Chicago, has been awarded the contract for moving St. Joseph Co. Court House at South Bend, Ind. It is an all stone building, 35 ft. high, 65 × 93 ft. Mr. Sheeler has also recently completed the moving of the Immanuel Baptist Church of Chicago, an all stone building, a distance of 51 ft.

THE BARIE BRICK CO., recently organized at Pittsburg, has nearly completed its plant at Johnstown, Pa., and will put it in operation at once. The building is constructed entirely of iron and brick, and is claimed to be fire proof in every detail. It is equipped with modern machinery and will have a capacity of 15,000 bricks per day.

THE ENSIGN MFG. CO., of Huntington, W. Va., has contracted with the Norfolk & Western Railway for 500 gondola cars, to be of large size and supplied with Henson couplers.

H. M. PEPPARD, of Minneapolis, Minn., who received the contract for the extension of the Duluth & Winnipeg Co.'s dock at Superior, Wis., as noted in our issue of last week, has opened an office in Superior, in the Northern block on West 5th St., and has commenced building the extension.

CHARLES L. SEABURY & CO., of Nyack-on-Hudson, have been awarded the contract for building a 140-ft. composite steam yacht for a New York party.

NEW COMPANIES.—The Conenaga Mfg. Co., New York, N. Y.; to manufacture woven felt, felted paper, pulp, etc., $25,000; John C. McLaughlin, Brooklyn, Henry L. Carter, Overbrook, Pa., A. A. Hurd, Lawrence, N. Y., and others.

The Aberthan Construction Co., New York, N. Y.; to furnish builders supplies, etc., $50,000; Henry H. Cohn, Charles Zunz, Ira C. Hutchinson, of New York and Robt. F. Tucker, of Boston.

The H. H. Franklin Mfg. Co., Syracuse, N. Y.; to make and sell metal castings, etc.; $100,000; Robert R. Franklin, James Parr Gedder, G. H. Stilwell and others, of Syracuse.

The Northville Granite Co., of Northville, N. Y.; to mine and deal in granite, etc.; $10,000; Erastus Darling, Gloversville, N. Y., T. A. Cole, T. E. Rees and others, of Northville.

Mergenthaler Linotype Co., Brooklyn, N. Y.; to make and sell machines; $10,000,000; William C. Whitney, D. O. Mills, T. J. Regan and P. P. Dodge, of New York.

The Jensen Paving Co., Russell, Clark County, Wash.; $100,000; F. S. Aiken, Theodore Jensen, Louis Sohns.

The Strohm Safety Device Co., Philadelphia, Pa.; to make safety appliances for elevators; $100,000; Richard R. Quay, Sewickly, Pa., Charles S. McKee, Pittsburg; David Martin and others of Philadelphia.

The Huckle & Sexton Contracting & Bldg. Co., of Kansas City, Mo.; $50,000; George Huckle, Samuel Sexton and Robert H. Hamilton.

The Cirkel Mfg. Co., Boyd, Chippewa County, Wis.; to manufacture lumber, etc.; $80,000; August, Maria and Theodore Cirkel.

Western Union Bicycle Co., Chicago, Ill.; $150,000; Lewis D. Cartwright, George R. Bennett and Chas. R. Rode.

Albion Construction Co., Chicago, Ill.; $25,000; William H. Fitzgerald, Wm. Black and Albert H. Vollinture.

The Ashtabula Gas Co., Ashtabula, O.; $80,000 Geo. W. Wright, Edwin S. Templeton, George B. Siddall, Frank A. Quail and Louis S. Lornmasson.

Franklin Co., Bound Brook, N. J.; $10,000, with $2,000 paid in; to manufacture and deal in paints, oils, cements, etc.; Wm. W. Smalley, Leigh S. Bache, Ralph R. Bache and Sylvanus G. Leake, of Bound Brook, N. J., and John A. Blair, of Jersey City, N. J.

The Chicago Indestructible Sanitary Closet Bowl Mfg. Co., Chicago, Ill.; $100,000; Henry Gill, Henry W. Cannon and Abram E. Burner.

The Fairmount Park & Beach Co., Trenton, N. J.; to build pleasure resorts, hotels, etc.; $250,000; Abram L. Warner, John Kildarhouse, and Henry Weill, all of Buffalo, N. Y.

The Garry Iron & Steel Roofing Co., Cleveland, O.; $250,000; Benjamin F. Powers, George E. Needham, Eugene R. Ahlfeld, Eubert C. Powers and C. B. Lockwood.

The California Engineering & Premotion Co., San Francisco, Cal.; $100,000; H. A. Greene, P. P. Dandridge, P. J. Field, of Monterey and Thomas R. Knox and R. B. Elder, of San Francisco.

The Troy Steel Co., Troy, N. Y., to manufacture steel and fertilizers, and the products made from the waste of such manufactures; $2,500,000; George A. Bell, Troy, N. Y.; Philip G. Bartlett, Henry H. Rogers, Hamilton H. Durand and Alfred B. Thacher, of New York; Frank S. Witherbee, of Port Henry, N. Y., and James S. Morgan, of Rye, N. Y.

The Southern States Telephone Co., Baltimore, Md.; to manufacture electrical apparatus, construct lines, etc., etc.; $100,000; Augustus G. Davis, J. Austin Fink and Wm. M. Winklemann, of Baltimore and R. B. Hazlett and Charles E. Fink, of Carroll county.

The Chemical Specialty Co., New York, N. Y., to manufacture articles for polishing metals; $10,000; Benjamin F. Lawson, Brooklyn; J. B. Willcome, New York, and C. W. Knappe, Rutherford, N. J.

The International Dry Dock & Construction Co., New York, N. Y.; $300,000; James A. Townsend and Wallace Downey, of Brooklyn, N. Y., and Charles C. Durkee, of New York city.

Cheever, Coit & Co., New York city; to manufacture bicycles; $60,000; Victor E. Burke, Geo. W. Ibl, and Lemuel Evans.

Pioneer Gold Mining Co., San Francisco, Cal., to mine ford gold, silver, etc., to build dams, reservoirs, tunnels, canals, etc., for mining, irrigation and other purposes; $2,000,000, all paid in; John Barton, City of Alameda; John Curry and Thomas Byron of San Francisco, Cal.; L. F. Preichling and George Goodman of Oakland.

The Metropolitan Electric Surface Ry. Co., New York city; $5,000,000; to acquire patents, rights and inventions relating to the construction and operation by electric power, street and other railroads; to generate and acquire electricity, etc, etc.; Wm. Lawrence, 151 E. 86th St., J. O. Fowler, Jr., 119 W. 42d St., W. H. Merritt, 4 E. 42d St., W. Cooper, 4 E 42d St., and H. S. Starke, 32 E. 42d St., all of New York.

The Street Railway Power Co., New York, N. Y.; $1,000,000; to produce, purchase, acquire, etc., improvements, letter patents, etc., for the production and application of power for the propulsion of street railway cars, etc., Thomas B. Jones, 115 Waverly Place, George E. Bouchie, Charles J. Brooks, Charles P. Bruch and John Doran, all of New York.

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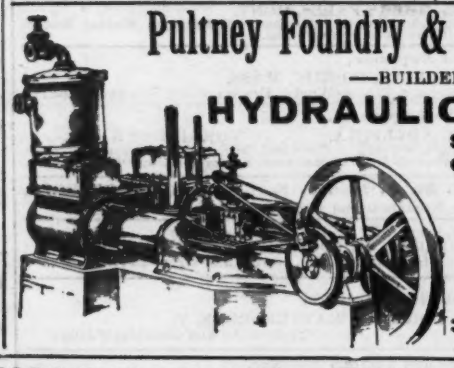

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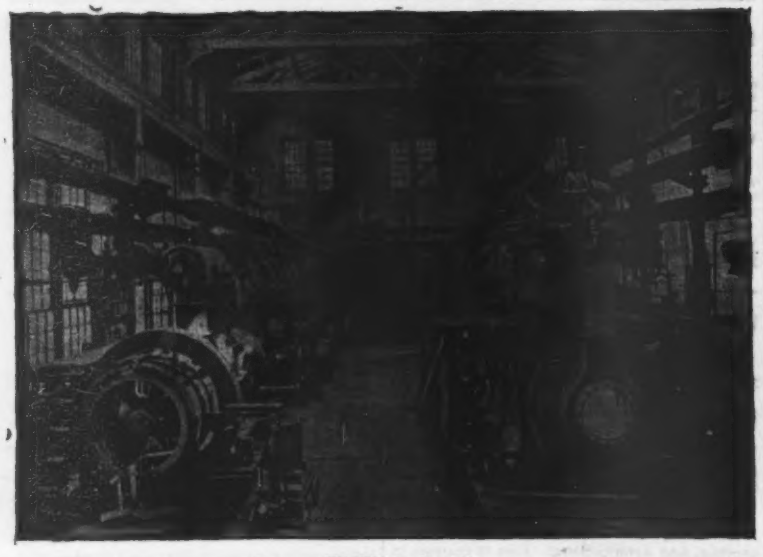

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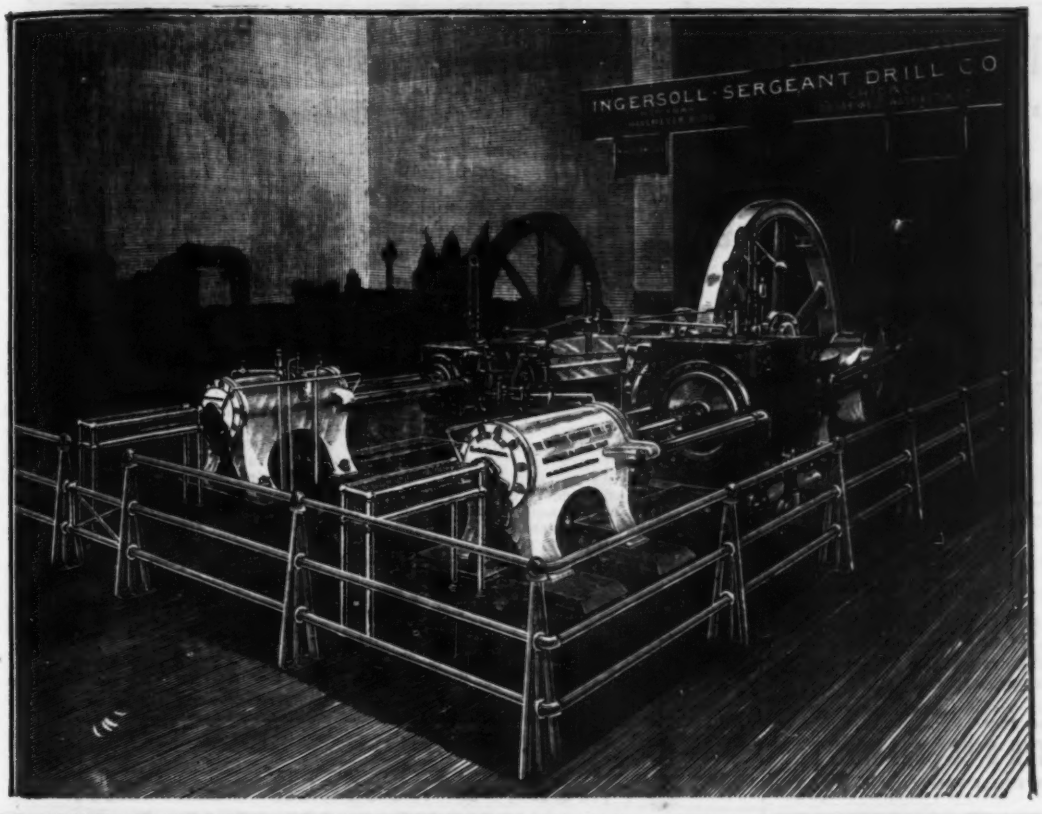

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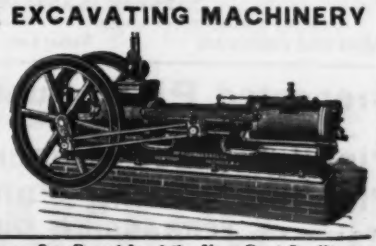

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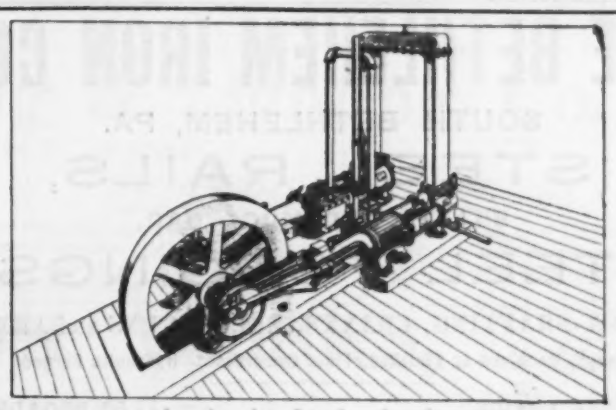

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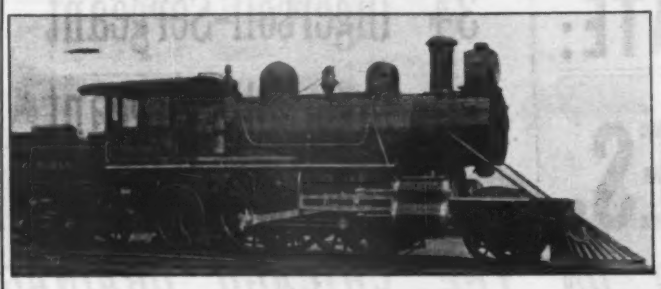

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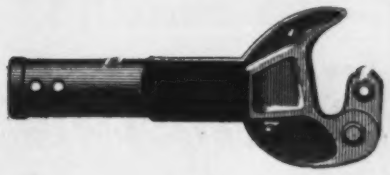

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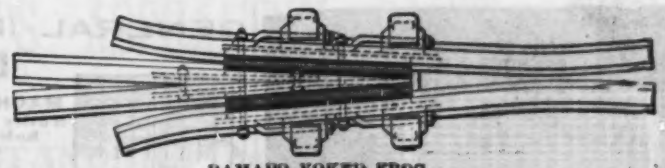

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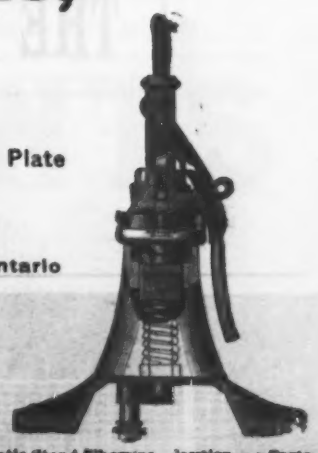

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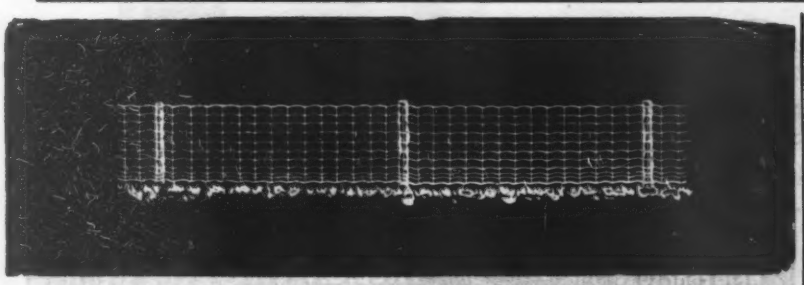

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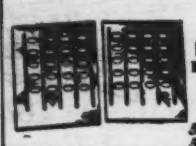

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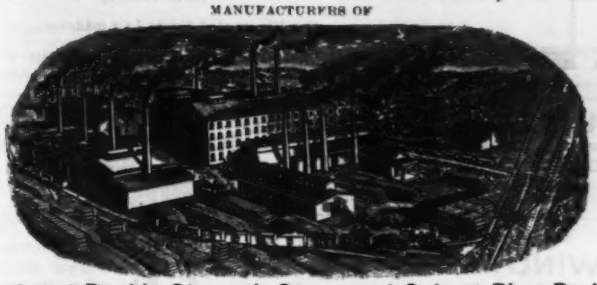

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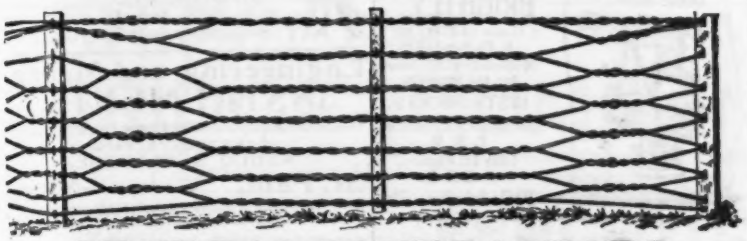

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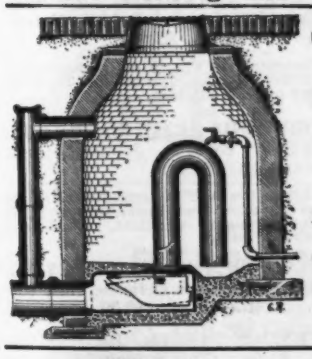

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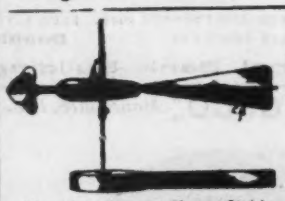

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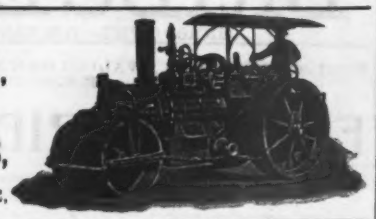

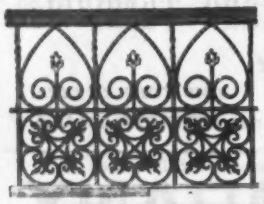

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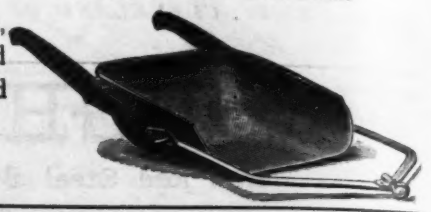

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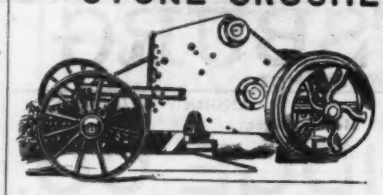

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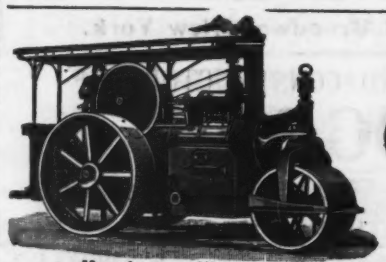

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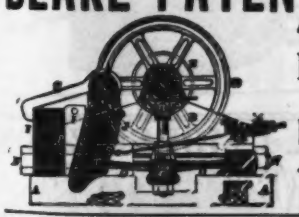

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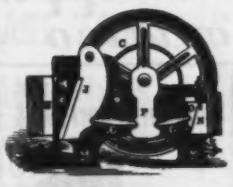

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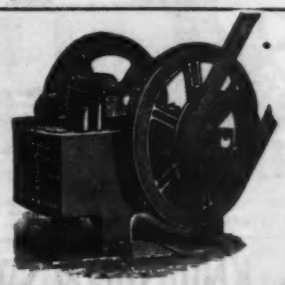

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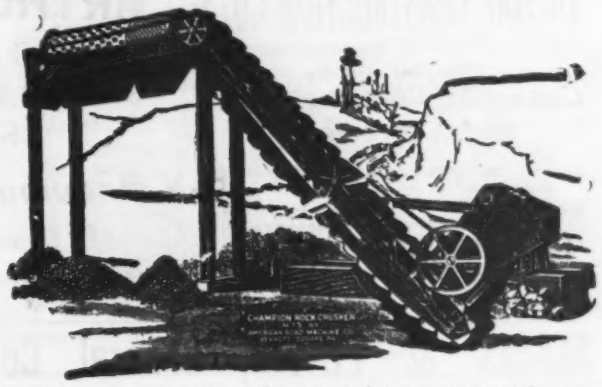

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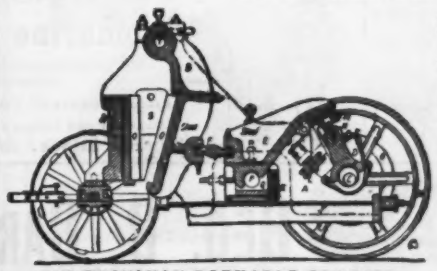

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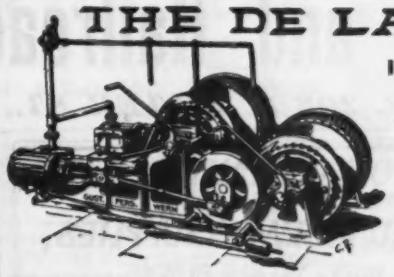

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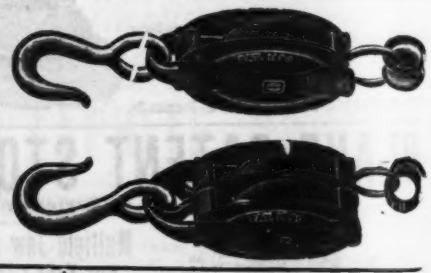

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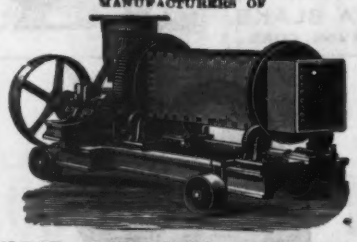

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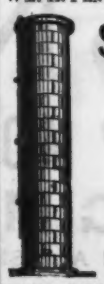

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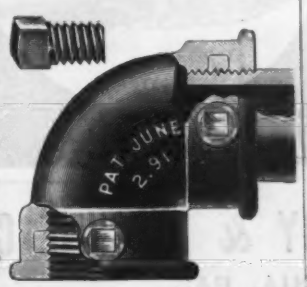

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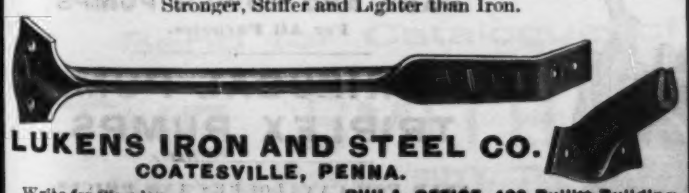

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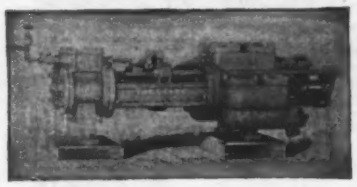

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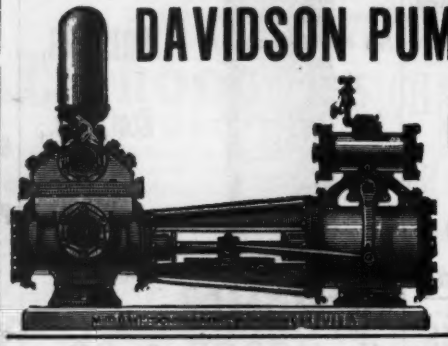

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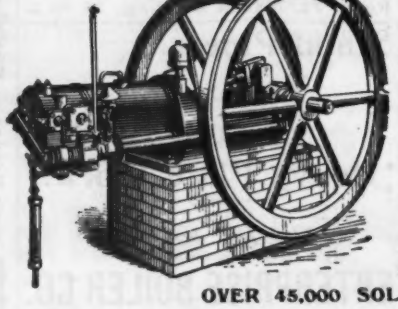

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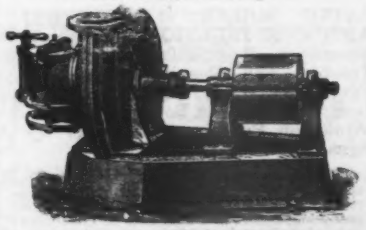

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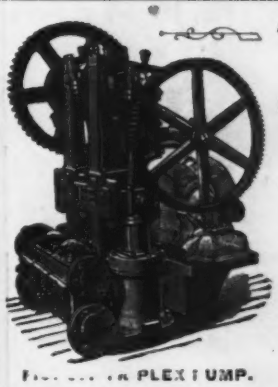

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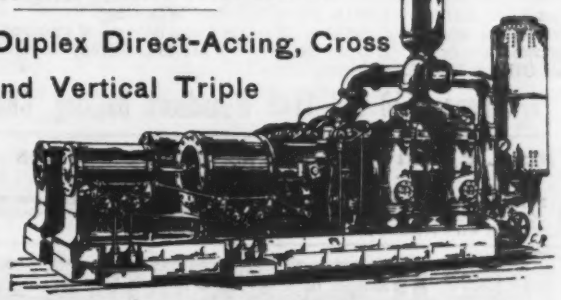

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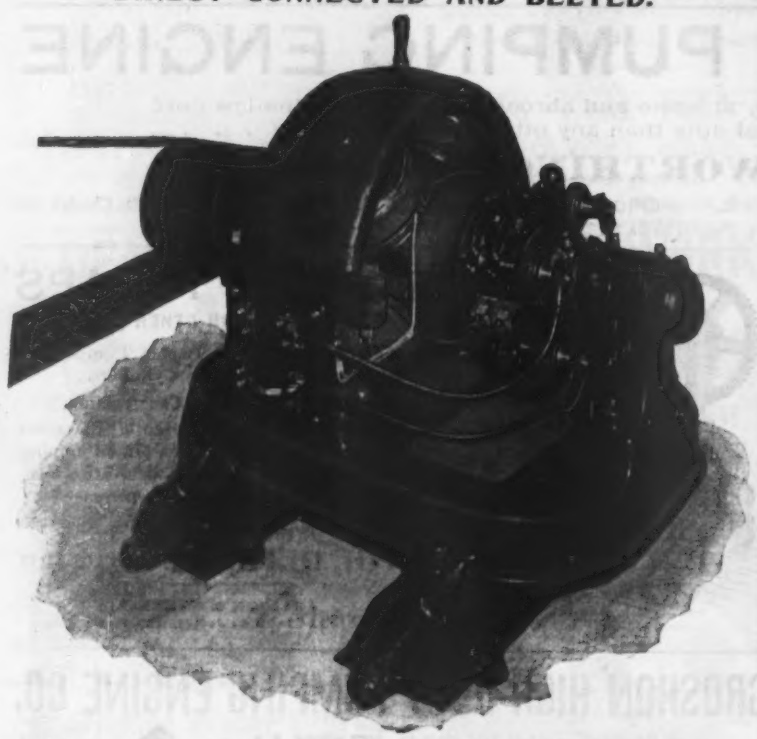

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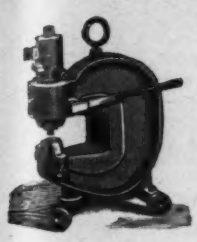

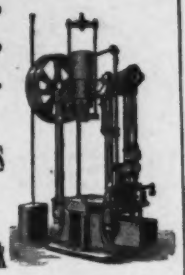

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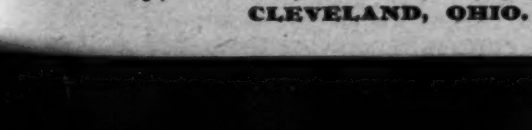

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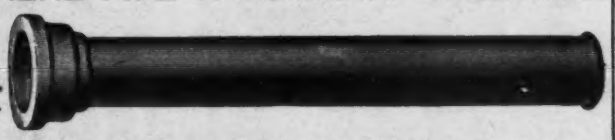

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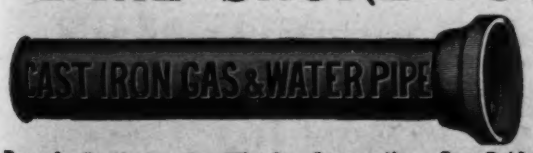

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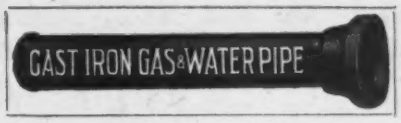

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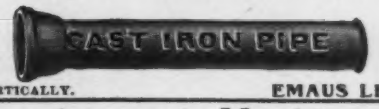
WATER  AND GAS

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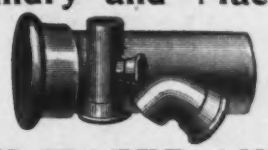

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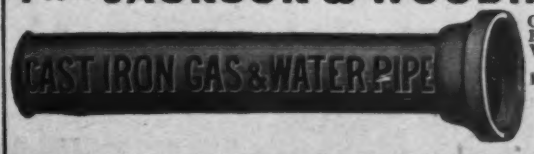

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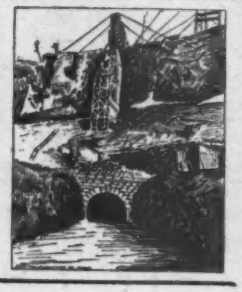

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ATLAS CEMENT COMPANY 143 LIBERTY ST. NEW YORK CITY

ASPHALT PAVEMENTS.

TRINIDAD THE BARBER ASPHALT PAVING CO. GENUINE ASPHALT TRADE MARK

THE BARBER ASPHALT PAVING COMPANY,
1 BROADWAY, NEW YORK,
Received the Highest Awards at the World's Columbian Exposition, Chicago, 1893: 1st, Asphalt and Asphaltic Cements; 2d, Trinidad Asphalt Pavements; 3d, Machinery and Processes

Classified Directory of Current Advertisements in Engineering News.

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Clayton Air Compressor Works, N.Y.
Deane Steam Pump Co., Holyoke, Mass.
Ingersoll-Sergeant Drill Co., N. Y.
Kirk, Arthur, & Son, Pittsburg, Pa.
McKiernan Drill Co., 126 Liberty St., N.Y.
Norwalk Iron Works Co., So. Norwalk, Conn.
Rand Drill Co., 23 Park Place, New York.
Air Brakes.
Westinghouse Air Brake Co., Pittsburg, Pa.
Aluminum.
Pittsburg Reduction Co., 701 Ferguson Block, Pittsburg, Pa.
Anti-Friction Metal
Young Lock Nut Co., New York.
Architects.
Howell, D. J., Washington, D. C.
Wilson Bros. & Co., Drexel Bldg., Phila., Pa.
Artesian Wells.
Cook Well Co., St. Louis, Mo.
Gregory, Elisha, 48 Church St., New York
Asphalt Paving.
Barber Asphalt Pav. Co., 1 B'way, N. Y.
Neucatel Asphalt Co., 246 B'way, N. Y.
N. Y. & Bermudez Co., 25 Beaver St., N. Y.
N.Y. Mastic Works., New York.
Sicilian Asph. Pav. Co., Times Bldg N.Y.
Thiele, E., 78 William St., City.
Warren-Scharf Asphalt Pav. Co., N. Y.
Bearings.
Holmes' Fibre-Graphite Mfg. Co., Phila.
Belt Dressing.
Jos. Dixon Crucible Co., Jersey City, N.J
Boiler Brace.
Lukens Iron & Steel Co., Coatesville, Pa.
Boilers.
Adams Boiler Co, Cleveland, O
Brownell & Co., Dayton, O.
Carlins' Sons, Thos., Allegheny, Pa.
Carlisle Mfg. Co., Carlisle, Pa
Clonbrock Steam Boiler Co., Brooklyn, N. Y.
East Chicago Boiler & Tank Works, East Chicago, Ind.
Enterprise Boiler Co., Youngstown, O.
Forsaith, S. C. & Co., Manchester, N. H.
Harvey Boiler Works, Harvey, Ill.
Hodge & Co., S., East Boston.
Moyes, L. M., Philadelphia, Pa.
Mundy, J. S., Newark, N. J.
Riter & Conley, Pittsburg, Pa.
Robert Poole & Son Co., Baltimore, Md.
Sharon Boiler Works, Ltd., Sharon, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Boiler Tubes.
Morris, Tasker & Co., Philadelphia
Boiler Fronts and Fittings
Vulcan Iron Works Co., Toledo, O.
Brakes.
Westinghouse Air Brake Co., Pittsb'gh, Pa
Brake-Shoes
Young Lock Nut Co., New York.
Brick and Tile.
Jackson, John H., Albany, N. Y.
Park Paving Co., Pittsburg, Pa.
Pittsburg Terra Cotta Lumber Co., Pittsburg, Pa.
Tomkins, Calvin, 32 Liberty St., N. Y.
Bridge Timber.
Bush & Son, Geo. W., Wilmington, Del.
Bridges, Viaducts, Buildings and Roofs.
Berlin Iron Bridge Co., E. Berlin, Conn.
Bonzano (A. & Clarke (T. C.), 44 B'way N. Y.
Boston Bridge Works, Boston, Mass.
Bonscaren, G., Cincinnati, O.
Buffalo Bridge & Iron Wks. Buffalo, N.Y.
Champion Bridge Co., Wilmington, O.
Chicago Bridge and Iron Co., Chicago.
Clarke, T. C., 44 Broadway, N. Y.
Cooper, Theodore, 35 Broadway, N.
Elmira Bridge Co., Elmira, and New York.
Evans, L. P., Philadelphia, Pa.
Groton Bridge & Mfg. Co., Groton, N. Y.
Hawkins, P. F., Iron Works
Indiana Bridge Co., Munice, Ind.
King Bridge Co., Cleveland, O.
Lehmann, Karl L., 1741 Monadnock Block, Chicago
Lowett, Chas. F., 560 Drake Bldg., St. Paul, Minn.
Massilon Bridge Co., Massillon, O.
Mo. Valley Bridge & Iron Works, Leavenworth, Kan.
Modjeski, Ralph, Monadnock Chgo.
New Columbus Bridge Co., Columbus, O.
Nichols & Bro., Geo. H., Monadnock Bldg., Chicago, Ill.
Passaic Rolling Mill Co., Paterson, N. J.
Pittsburg Bridge Co., Chicago
Penn Bridge Co., Beaver Falls, Pa.
Phoenix Bridge Co., Phoenixville, Pa.
Riter & Conley, Pittsburg, Pa.
Rochester Bridge & Iron Works, Rochester.
San Francisco Bridge Co., San Francisco
Schultz Bridge & Iron Co., Pittsburg, Pa.
Shaller & Schmidau, Chicago, Ill.
Sharon Boiler Works, Ltd., Sharon, Pa.
Shaw, Edw. S., 12 Pearl St., Boston, Mass
Shiffler Bridge Co., Pittsburg, Pa.
Sooysmith & Co., Mills Building, N. Y.
Stebbings, W. L., 1113 Monadnock Block, Chicago,
Toledo Bridge Co., Toledo, O.
Union Bridge Co., 1 Broadway, N. Y.
Valle & Young, Baltimore, Md.
Variety Iron Works Co., Cleveland, O.
Waddell, J. A. L., Kansas City, Mo.
Wrought Iron Bridge Co. Canton, O.
Youngstown Bridge Co., Youngstown
Bridge Railings.
Albree Chester B., Allegheny, Pa.
Belmont Iron Works Philadelphia, Pa.
Van Dorn Iron Works Co., Cleveland, O.
Brushes.
Holmes' Fibre-Graphite Mfg. Co., Phila.
Cableways (Suspension).
Beatty, M., & Sons, Welland, Ont.
Crook (W. A.) & Bros. Co., Newark, N.J
Lidgerwood Mfg. Co., Liberty St., N. Y.
Poole & Son Co., Robt. Baltimore, Md.
Watkins, Louis E., 30 Court St., Boston.
Cable Railways (Builders of),
Christie & Lowe, Ashland Blk., Chicago.
Cable Railway Driving Plants.
Poole, Robt., & Son Co., Baltimore, Md.
Cars (Dump, Plantation and Flat, Hand Logging, Mining and Freight).
Bloomsburg Car Co., Bloomsburg, Pa.
Buda Foundry & Mfg. Co., Harvey, Ill.
Carlisle M'f'g Co., Carlisle, Pa.
Jackson & Woodin M'f'g Co., Berwick, Pa.
Sheffield Car Co., Three Rivers, Mich.
Stenbner, G. L. & Co., Long Isl'd City, N.Y.
Cars (Railroad, Passenger and Freight)
Bloomsburg Car Co., Bloomsburg, Pa.
Carlisle Mfg. Co., Carlisle, Pa
Cars (Wrecking and Ditching).
Industrial Works, Bay City, Mich.
Marion Steam Shovel Co., Marion, O.
Osgood Dredge Co., Albany, N. Y
Vulcan Iron Works Co., Toledo, O.
Car Heating and Lighting.
Consolidated Car-Heat'g Co., Albany, N.Y.
The Safety Car-Heating and Lighting Co., 160 Broadway, New York.
Car Couplers.
Consolidated Car-Heat'g Co., Albany, N.Y.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
McGowan & Torley Co., Pittsburg, Pa.
Railroad Supply Co., Owings Bldg, Chicago
Car Unloaders.
Marion Steam Shovel Co., Marion, O.
Toledo F'dry & Mach. Co., Toledo, O
Car Wheels.
Buda Foundry & Mfg. Co., Harvey, Ill.
Jackson & Woodin Mfg. Co., Berwick, Pa.
Lake Shore Foundry, Cleveland, O.
Ramapo Iron Works, Hillburn, N. Y.
Castings (Car and Engine).
Ohio Pipe Co., Columbus, O
Cattle Guards.
Q. & C. Co., Chicago Ill.
Railroad Supply Co., Owens Bldg., Chicago, Ill
Cement.
Alsen's Portland Cement Works, N. Y.
Atlas Cement Co., 143 Liberty St., N. Y.
Ponneville, A. B., Siegfried, Pa.
Brand, James, 81 Fulton St., N. Y.
Buckeye Portland Cement Co., Bellefontaine, O.
Commercial Wood & Cement Co., Girard Bldg., Phila.
Empire Portla'd Cement Co., Warners, N.Y
Haebler & Co., 71 Wall St., New York.
Hall & Co., Edwin, Philadelphia, Pa.
Johnson & Wilson, 45 Broadway, N. Y
Kelly Island Lime & Transportation Co., Cleveland, O.
Lawrence Cement Co., 67 William St., N.Y.
Lawrenceville Cement Co., Havemeyer Bldg., New York.
Lesley & Trinkle, 210 So. Third St., Phila.
Meacham & Wright, 98 Market St., Chicago
Newcomer, G. M., 128 Liberty St., N. Y
Norton Cement Co., F. O., 92 B'way, N. Y.
New York & Rosendale Cement Co., N. Y.
Tomkins, Calvin, 32 Liberty St., N. Y.
Thiele, E., 78 William St., N. Y.
Union Akron Cement Co., Buffalo, N. Y.
Western Cement Co., 347 W. Main St., Louisville, Ky.
Cement Dryer and Roaster.
P. D. Cummer & Son Co., Cleveland, O.
Cement Sidewalks, Etc.
Masters & Co., Cleveland, O.
Chains
Link Belt Machinery Co., Chicago, Ill.
McKay & Co., James, Pittsburg, Pa.
Chemists.
McKenna, Chas. F., 221 Pearl St., New York City.
Pittsburg Testing Laboratory Ltd., Pittsburg, Pa.
Coal Handling Machinery.
Brown Hoisting and Conveying Co., Cleveland, O.
Link Belt Machinery Co., Chicago, Ill.
G. L. Steubner & Co., Long Island City, N.Y.
Watkins, Louis E., 30 Court St., Boston.
Colleges (Engineering).
Harvard Univ., Cambridge, Mass.
Penn. Military Acad., Chester, Pa.
Rensselaer Polytechnic Inst., Troy, N. Y.
University of Illinois, Champaign, Ill.
Western Univ. of Penn., Allegheny, Pa.
Concrete Mixer.
Cockburn Barrow & Machine Co., Jersey City, N. J.
Contractors.
Abbott-Grimble Contracting Co., St. Louis, Burns & Egan Chamber of Commerce, Chicago.
Christie & Lowe, Ashland Blk., Chicago.
Evans Louis P., 436 Walnut St., Phila., Pa.
Glaver, J. G. & Co., The Monadnock, Chicago
Harlow, J. H., & Co., Pittsburg, Pa.
Kearns & Egan, Philadelphia, Pa.
Kelly & Atkinson, Security Bdg. Chicago.
Kinnear (T. W.) & Sons, Chicago Stock Exchange, Chicago, Ill.
Mairs & Lewis, 13 Broadway, N. Y.
Arthur McMullen & Co., N. Y.
Quigley, R. M. & Co., St. Louis, Mo.
Rann, Frank, 138 E. Kinzie st., Chicago.
Seckner Contracting Co., Unity Bldg., Chicago.
Sheeler, H., 85 Washington St., Chicago.
Toledo Construction Co., Toledo, Ohio.
Van Aken & Hays, Washington, D. C.
Van Sandt & Meeds, Cincinnati, O.
Woltmann, Keith & Co., 11 Wall St., N. Y
Contractors' Insurance.
City Trust & Safe Deposit Co Phila., Pa
Fidelity & Deposit Co of Maryland, Baltimore, Md.
Contractors' Machinery.
American Hoist & Derrick Co., St. Paul.
M. Beatty & Sons, Welland, Ont.
Byers, John F., Machine Co., Ravenna, O
Carlin's Sons, Thos, Allegheny, Pa.
Carpenter & Co, Geo. B, Chicago.
Carson Trench Machine Co., Boston, Mass,
Channon Co., H., Chicago, Ill.
Contractors' Plant Mfg. Co., Buffalo, N. Y.
Crook (W. A.) & Bros. Co., Newark, N. J.
DeLaVergne Refrigerating Machine Co., New York.
Dunn Mfg. Co., Ltd., Pittsburg, Pa.
Halpin, Wm., 47 Washington St., N. Y.
Ingersoll-Sergeant Drill Co., N. Y.
Lidgerwood Mfg. Co., 96 Liberty St., N. Y.
Link Belt Machinery Co., Chicago. Ill.
McKeown, H. J., 96 E. Front St., Cincinnati, O.
Missouri Dredge Co., Kansas City, Mo.
Mundy, J. S., Newark, N. J.
Shaw Willis, N. Y Life Bldg, Chicago, Ill
Sheeler, H, 85 Washington St., Chicago.
Sidney Steel Scraper Co., Sidney, O
Souther, John, & Co., Boston, Mass.
Sullivan Machinery Co., Chicago.
Toledo F'dry & Mach. Co., Toledo, O.
Vulcan Iron Works Co., Toledo, O.
Whiting Foundry Equipment Co., Monadnock Bldg., Chicago, Harvey, Ill.
Creosoting.
Allen, Otis, & Son, Lowell, Mass.
Eppinger & Russell Co., New York City.
Fernandina Oil and Creosote Works, Fernandina, Fla.
Fernoline Chemical Wks., Charlest'n, S.C.
Lehigh Valley Creosoting Works, 1 Broadway, New York.
Michigan Pipe Co., Bay City, Mich.
Old Dominion Creosoting Works, 37 Main St., Norfolk, Va.
Vanderbilt & Hopkins, 126 Liberty St., N.Y.
Current Motors.
Haskell, E. E., Sault Ste. Marie, Mich.
Hitchcock, R. S., & Sons, Brookline, Mass.
Differential Hoists
Boston & Lockport Block Co., Boston, Mass
Ditching and Grading Machines, Excavators.
Austin, F. C., Mfg. Co., Chicago, Ill
Beatty, M., & Sons, Welland, Ont.
Marion Steam Shovel Co., Marion, O.
Osgood Dredge Co., Albany, N. Y.
San Francisco Bridge Co., San Francisco, Cal.; Seattle, Wash., and 123 World Bldg., N. Y.
Shaw, Willis, N. Y. Life Bldg., Chicago, Ill.
Souther, John, & Co., Boston.
Toledo Foundry & Machine Co., Toledo, O
Vulcan Iron Works, Chicago.
Vulcan Iron Works Co., Toledo, O.
Divers.
Falcon, Jos. G., Evanston, Ill.
Knudson & Son, 374 Washtenaw Ave., Chicago, Ill.
Thacher & Breymann, Jefferson & Water Sts., Toledo, O.
Williams, Capt. John, Thurlow, Pa.
Diving Apparatus.
Morse, A. J., & Son, 140 Congress St., Boston
Schroeder, A., & Son, 32 Rose St. N.Y.
Drain Tile.
Jackson, John H., Albany, N. Y.
Monmouth Mg. & Mfg. Co., Monmouth, Ill
White Hall Fire Clay W'ks, White H'll, Ill
Drawbridge Machinery.
Nichols & Bro., Geo. H., Monadnock Bldg. Chicago.
Dredging & Dredging Machinery
Atlantic Dredging Co., New York.
Beatty, M., & Sons, Welland, Ont.
Bowers, A. B., San Francisco, Cal
Bucyrus Steam Shovel & Dredge Co., So. Milwaukee, Wis.
DuBois', Henry, Sons., 119 South St., N. Y
Industrial Works, Bay City, Mich.
Marion Steam Shovel Co., Marion, O
McKeown, H. J., 96 E. Front St., Cincinnati, O.
Mining & Dredging Power Co., 68 Broad St., New York
Deming Co, Salem, O.
Missouri Dredge Co., Kansas City, Mo.
Mundy, J. S., Newark, N. J.
New York Dredging Co., World Bldg., N.Y
Osgood Dredge Co., Albany, N. Y
Poole, Robt. & Son Co., Baltimore, Md.
Ross, P. Sanford, Jersey City, N. J.
San Francisco Bridge Co., San Francisco
Cal.; Seattle, Wash., and 123 World Bldg., N. Y
Toledo Foundry & Machine Co., Toledo, O.
Vulcan Iron Works, Chicago, Ill.
Vulcan Iron Works Co., Toledo, O.
Drilling, Tapping, Reaming and Boring Machines (Portable).
Stow Flexible Shaft Co., Phila., Pa
(See Rock Drills.)
Dryer and Roaster.
P. D. Cummer & Son Co., Cleveland, O.
Dynamite and Electric Blasting Apparatus.
Aetna Powder Co., Chicago, Ill.
Kirk, Arthur, & Son, Pittsburg, Pa.
Rendrock Powder Co., 23 Park Pl., N. Y.
Dynamos.
Gates Electric Mfg. Co., Chicago.
Electric Conduits.
Michigan Pipe Co., Bay City, Mich.
Electric Railway and Light Poles
Morris, Tasker & Co., Philadelphia.
Enameled Signs.
F. E. Marsland, 34 W. Broadway, N. Y.
Engines (Gas or Gasoline)
Otto Gas Engine Works, Philadelphia, Pa.
Engines (Hoisting).
American Hoist & Derrick Co., St. Paul.
Beatty, M., & Sons, Welland, Ont.
Byers, John F., Machine Co., Ravenna, O
Channon Co., H., Chicago, Ill.
Carlins' Sons, Thos., Allegheny, Pa.
Forsaith, S. C., & Co., Manchester, N. H.
Industrial Works, Bay City, Mich.
Mundy, J. S., Newark, N. J.
Engines (Stationary).
Carlins' Sons, Thos, Allegheny, Pa.
Carlisle Mfg. Co., Carlisle, Pa.
Forsaith, S. C., Machine Co., Manchester N. H.
Poole, Robert, & Son Co., Baltimore, Md.
Pulsometer Engineering Co., Reading, Eng.
Pulsometer Steam Pump Co., New York
Snow Steam Pump Wks., Buffalo, N. Y
Southwark Foundry & Machine Co., Phila. Pa
Stillwell-Bierce & Smith-Vaile Co., Dayton, O
Van Wie, Irwin, Syracuse, N. Y.
Worthington, Henry R., New York.
Rack Railways (Abt)
W. Hudebrand, 1 Broadway, N. Y.
Rail Joints.
McGowan & Torley Co., Pittsburg, Pa
Rails (Steel).
Hoyt & Abbott, Atlanta, Ga.
Robinson & Orr, Pittsburg, Pa.
Railway Equipment.
Carlisle Mfg. Co., Carlisle, Pa.
Channon Co., H., Chicago, Ill.
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Railroad Supply Co., Owings Bldg., Chic
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Weir Frog Co., Cincinnati, O.
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Harrisburg Foundry & Machine Works Harrisburg, Pa.
Kelly Co., O. S., Springfield, O.
Pioneer Iron Works, Brooklyn, N. Y.
Pitts Agricultural Wks., Buffalo, N. Y.
Rock Drills.
Clayton Air Com. Works, 26 Cort'dt st., N.Y
Ingersoll-Sergeant Drill Co., N. Y.
King, Arthur, & Son, Pittsburg, Pa.
McKiernan Drill Co., 126 Liberty St., N. Y.
Rand Drill Co., N. Y. City.
Sullivan Machinery Company, Chicago.
Rock and Ore Crushers.
American Road Mf'g Co., Kennett Sq., Pa.
Earl C. Bacon, 1 Havemeyer Bldg., N.Y.
Beckett Foundry & Machine Works, Arlington, N. J.
Blake, Theo. A., New Haven, Conn.
Farrel Foundry & Mach. Co., Havemeyer Building, New York.
Kirk, Arthur, & Son, Pittsburg, Pa.
Pierce & Miller Engineering Co., 42 Cortlandt St., N. Y.
St. Johnsville Agri. Wks., St. Johnsville, N Y
Young-Brennan Crusher Co., Brooklyn
Rolling Mill Machinery.
Poole & Son Co., Robt., Baltimore, Md.
School.
Correspondence School of Technology, Cleveland, O.
International Correspondence Schools, Scranton, Pa.
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Dunn Mfg. Co. Pittsburg, Pa.
Sewer Excavating and Hoisting Apparatus.
Brown Hoist. & Convey. Mach. Co. Cleve'l'd
Carson Trench Machine Co., Boston, Mass.
Moore Mfg. Co., Buffalo, N. Y.
Watkins, Louis E., 30 Court St., Boston.
Sewage Pumping Machinery.
Laidlaw-Dunn-Gordon Co. Cincinnati, O.
Worthington, Henry R., 96 Lib'ty St., N.Y
Shafts.
Carpenter & Co., G. B., Chicago.
Poole & Son Co., Robt., Baltimore, Md.
Stow Flexible Shaft Co., Philadelphia, Pa
Shape Metal Cutting Machine.
D. Hammond & Sons, Canton, O.
Signs.
Marsland F. E., 34 West Broadway N. Y.
Valle & Young, Baltimore, Md.
Stand-Pipes and Tanks.
Brownell & Co., Dayton, O.
Challenge Wind Mill & Feed Mill Co. Batavia, Ill.
Cunningham Iron Co., Boston, Mass.
East Chicago Boiler and Tank Work East Chicago, Ind
Enterprise Boiler Co., Youngstown, O
Harvey Boiler Works, Harvey, Ill.
Hodge, E., & Co., East Boston, Mass.
Riter & Conley, Pittsburg, Pa.
Sharon Boiler Works, Sharon, Pa.
U. S. Wind Engine & Pump Co., Batavia
Wood, R. D., & Co., 400 Chestnut St., Phila
Stationery Printing, etc.
Chas. F. Ketcham & Co., 27 Nassau St., N.Y
Steam Shovels.
Austin, F. C., Mfg. Co., Chicago, Ill.
Beatty, M. & Sons, Welland, Ont.
Marion Steam Shovel Co., Marion, O.
Osgood Dredge Co., Albany, N. Y.
New York Dredging Co., New York.
San Francisco Bridge Co., San Francisco, Cal.; Seattle, Wash., and 123 World Bldg., N. Y
Souther & Co., John, Boston, Mass.
Toledo Foundry & Machine Co., Toledo, O
Vulcan Iron Works, Chicago, Ill.
Vulcan Iron Works Co., Toledo, O.
Steam Specialties
D. Este & Seeley Co., Boston, Mass.
Steel Flangers.
Latrobe Steel Works, Latrobe, Pa.
Street Sweepers.
Austin, F. C., Mfg. Co., Chicago, Ill.
Tackle Blocks.
Boston & Lockport Block Co., Boston, Mass
Carpenter & Co., Geo. B., Chicago.
Tapping Machines (for Water and Gas Pipe)
Harlow & Co., J. H., Pittsburg, Pa.
Smith, Anthony P., Newark, N. J.
Telegraph Poles.
Michigan Pipe Co., Bay City, Mich.
Testing Laboratory.
Booth, Garrett & Blair, Philadelphia, Pa.
McFadden, Chas. & Son, 749 Walnut St. Philadelphia.
Olsen & Co., Tinius, Philadelphia, Pa.
Pittsburg Testing Lab'ry, Pittsburg, Pa
Riehle Bros., Philadelphia, Pa.
Testing Machines.
Olsen, Tinius, & Co., Philadelphia, Pa.
Riehle Bros. Testing Machine Co., Phila, Pa
Tie Plates.
Q. & C. Co., Chicago, Ill.
Track-Layer.
Roberts' Steam Track Layer Co., World Bldg., New York; Seattle, San Francisco
Transmission Machinery.
Poole, Robt., & Son Co., Baltimore, Md.
Trench Machines.
Brown Hoist. & Conv. Mach. Co., Cleve, O
Carson Trench Machine Co., Boston, Mass
Moore Mfg. Co., Buffalo, N. Y.
Turbines.
Risdon, T. H. & Co., Mount Holly, N. J.
Velocipedes (R. R.).
Sheffield Car Co., Three Rivers, Mich.
Wall Coping.
White Hall Fire Cl'y W'ks, White Hall, Ill
Water Gages.
Dibble, F. J., Peabody, Mass.
Reliance Gauge Co., Cleveland, O
Wheelbarrows.
Cockburn Barrow Co., L. I. City, N. Y
Cockburn Barrow & Mach Co., Jersey
Wire Rope.
Carpenter & Co., G. B., Chicago.
Trenton Iron Co., Trenton, N. J
Ferrari, Guido, Philadelphia, Pa.
Jurley, W. & L. E., Troy, N. Y
Heer, Peter, Chicago, Ill.
Heller & Brightly, Philadelphia.
Keuffel & Esser Co., 42 Ann St., N. Y.
Kolesch & Co., Fulton St., New York.
Kuhlo & Ellerbe, St. Paul, Minn.
Mahn & Co.
Post, Jacobi & Bruning Co., 218 Clark St., Chicago, Ill.
Randolph, T. F. Cincinnat, O.
Seelig & Kanaler 196 Madison St., Chicago.
Stieren, W. E., Pittsburgh, Pa.
Pfaser Herm., 176-180 Plum St. Cin'nati, O.
Veit (L.) & Co., Columbus, O.
Young & Sons, 43 N. Seventh St., Phila.
Labor (Italian).
Cuozzo, Donato 326 Broome St., N. Y. City
Martino, Pasquale, Brooklyn, N. Y.
Landscape Architect.
Howell, D. J., Nat. Union Bdg., Washington
Locomotives.
Baldwin Locomotive W'ks, Philadelphia.
Pittsburg Loco. & Car W'ks, Pittsb'rg, Pa.
Porter, H. K., & Co., Pittsburg, Pa.
Lubricants.
Carpenter & Co., G. B., Chicago.
Detroit Graphite & Mfg. Co., Detroit, Mich.
Jos. Dixon Crucible Co., Jersey City, N. J
Holmes Fibre-Graphite Co. Phila., Pa.
Lumber (Car and Bridge).
Bush & Son, Geo. W., Wilmington, Del.
Lehigh Vy. Creosot. Co., Jersey City, N. J
Vanderbilt & Hopkins New York.
Macadam Stone
Lane & Son, John S., Meriden, Conn.
Tomkins, Calvin, 32 Liberty St., N. Y.
Machinery and Castings (Heavy).
Poole & Son Co., Robt., Baltimore, Md.
Machine Tools.
Watson & Stillman New York.
Measuring Tapes.
Carpenter & Co., G. B. Chicago.
Eddy, Geo. M. & Co., 345-353 Classon Ave, Brooklyn, N. Y. See also "Instruments."
Meters (Water).
Buffalo Meter Co. Buffalo, N. Y.
Hersey Mfg. Co., South Boston, Mass.
Metropolitan Meter Co., Boston, Mass.
Neptune Meter Co., 253 Broadway, N. Y.
National Meter Co., 252 B'way, New York.
Thomson Meter Co., Brooklyn, N. Y
Union Water Meter Co., Worcester, Mass.
Worthington, Henry R., New York.
Monolithic Concrete Construction
Ransome Subway Co., Monadnock, Chicago.
Motors (Electric).
Gates Electric Mfg. Co., Chicago.
Motors (Water).
Backus Water Motor Co., Newark, N. J.
Bolgiano Water Motor Co., Baltimore, Md.
Worthington, H'y R., 96 Liberty St., N.Y.
Poole & Son Co., Robt., Baltimore, Md.
Nut Locks.
National Elastic Nut Co., Milwaukee, Wis.
Young Nut Lock Co., 15 B'way, New York.
Oil Engines.
Shipman Engine Co., Boston, Mass.
Ore Handling Machinery.
Brown Hoist. & Con. Mach. Co., Clevel'd, O.
Link Belt Machinery Co., Chicago, Ill.
Paints.
Carpenter & Co., G. B., Chicago.
Detroit Graphite Mfg. Co., Detroit, Mich.
Fernandina Oil and Creosote Works. Fernandina, Fla.
Jos. Dixon Crucible Co., Jersey City, N. J.
Murphy Bros., Pittsburg, Pa.
National Paint Works, Williamsport, Pa.
Edwd. Smith & Co., 45 B'way, New York.
Paving (Asphalt). See Asphalt Paving.
Paving Block (Stone).
Booth Bros. and Hurricane Island Granite Co., 60 Bank St., N. Y.
Paving Block (Wood).
Lehigh Vy. Creosoting Co., Jersey City.
Michigan Pipe Co., Bay City, Mich.
Paving Brick (Fire Clay).
Park Paving Co., Pittsburg, Pa.
Pile Driving Machinery.
American Hoist & Der'k Co., St. Paul, Minn.
Beatty & Sons, M., Welland, Ont.
Cram, R. J. & A. B., 32 Adams Ave., W. Detroit, Mich.
Industrial Works, Bay City, Mich.
McKeown, H. J., 96 E. Front St., Cin., O.
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BOOKS ON HYDRAULIC CEMENTS.

The literature on the subject of hydraulic cements has increased enormously in the last decade, principally through the medium of the publications of the various engineering societies, making it difficult to prepare a bibliography with any reasonable conciseness, so that we have attempted here to give only the best known and most valuable books to the general practitioner. To those of our readers who desire fairly complete lists of the various recent papers on the subject, we refer those published in Prof. Fred. P. Spalding's "Notes on the Testing and Use of Hydraulic Cements" and the "Stevens Indicator" of October, 1893, published at the Stevens Institute of Technology, Hoboken, N. J.

PRACTICAL TREATISE ON LIMES, HYDRAULIC CEMENTS AND MORTARS. By Lieut.-Col. Q. A. Gilmore, U. S. Engineer Corps. New York, 1890. 8vo, cloth, pp. 344. $4.00.

NOTES ON THE COMPRESSIVE RESISTANCE OF HYDRAULIC CEMENTS, MORTARS AND CONCRETES. By Lieut.-Col. Q. A. Gilmore, U. S. Engineer Corps. New York, 1890. 8vo, cloth, pp. 198, 8 folding plates. $3.50.

A MANUAL OF LIME AND CEMENT. By A. H. Heath. London, 1893. 12mo, cloth, pp. 215; $2.50.

PORTLAND CEMENT FOR USERS. By Henry Faija, M. Inst. C. E. London, New York, 1890. 12mo, cloth, pp. 106. $1.00.

NOTES ON CONCRETE AND WORKS IN CONCRETE. By John Newman, Assoc. M. Inst. C. E. London, New York, 1894. 12mo, cloth; pp. 236. $2.50.

THE STRENGTH OF CEMENT. By John Grant, M. Inst. C. E. London, New York, 1875. 8vo, cloth; pp. 172; 8 folding plates. $4.25.

NOTES ON THE TESTING AND USE OF HYDRAULIC CEMENTS. By Fred. P. Spalding. Asst. Prof. C. E., Cornell University, Ithaca, N. Y., 1893. 12mo, cloth; pp. 108. $1.00.

A TREATISE ON MASONRY CONSTRUCTION. By Prof. I. O. Baker, University of Illinois. New York, 1890. 8vo, cloth; pp. 552. $5.00. Seventy pages devoted to cements, etc.

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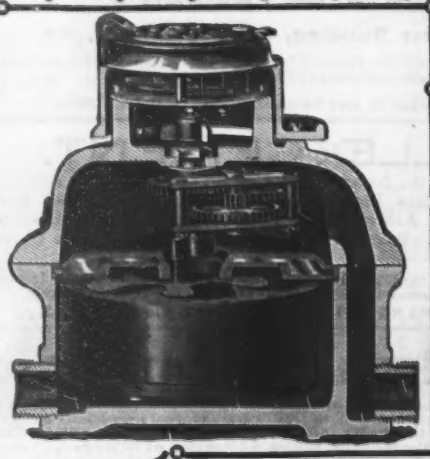

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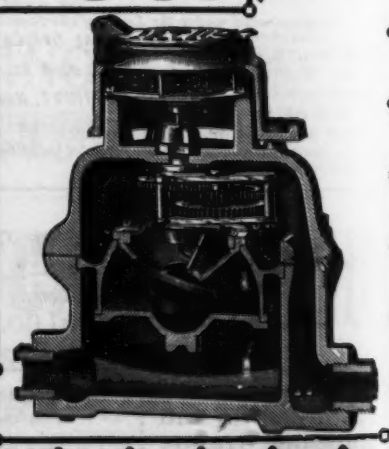

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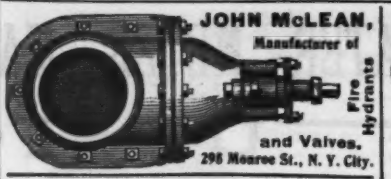

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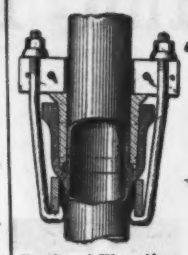

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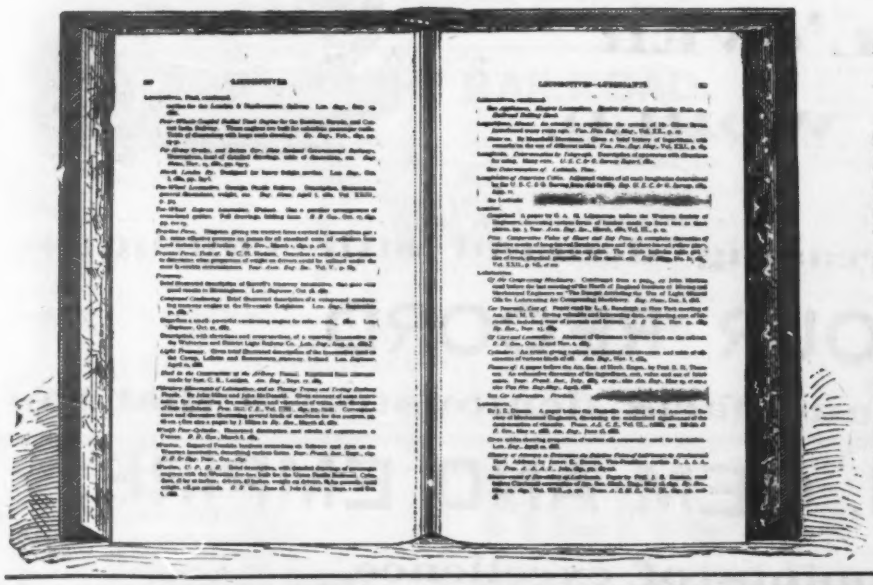

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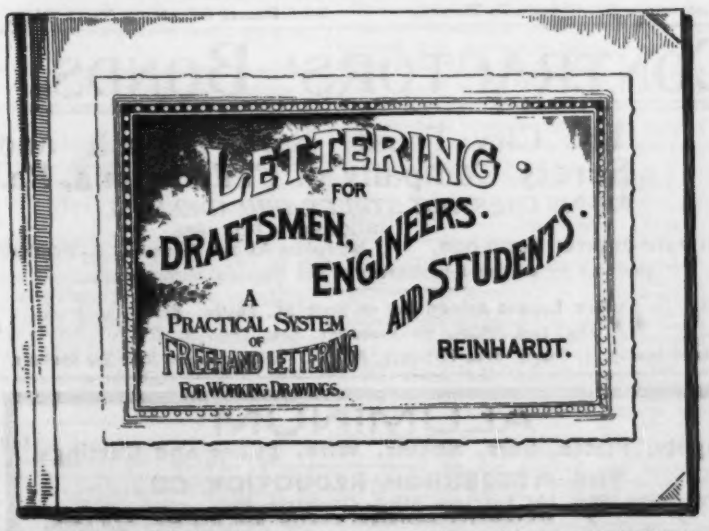

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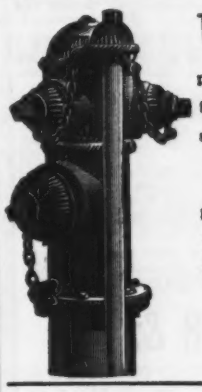

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Adopted by U. S. Government, State of Illinois, and many others.

Recommended by National Association of Fire Engineers, 1888.

Extract from appendix to report on hydrant tests, by Selim H. Peabody, Ph. D., LL. D., Regent University of Illinois:

BEAUMONT.....	6.2	Friction loss per cent. in lbs. per square inch in hydrants used without nozzle, 50 feet of hose.
LUDLOW [gate]. ..	25.5	
CREGIER [comp.]..	37.8	

Send for Full Report.

RICHARD BEAUMONT, Manufacturer

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MICHIGAN Brass & Iron Works,

MANUFACTURERS OF

GATE AND COMPRESSION FIRE HYDRANTS.

GATE VALVES FROM ¼" to 60"

FOOT VALVES, HORIZONTAL AND VERTICAL CHECK VALVES.

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CHICAGO HOUSE 20 West Lake St.

THE EDDY VALVE CO.

Waterford, New York,

GENERAL WESTERN AGENTS, JAMES B. CLOW & SONS CHICAGO.

C. L. PLEUGER, Pres. & Gen. M'g'r. H. W. HENGER B. H. SANDERS, Sec'y.

PLEUGER & HENGER MFG. CO.

FACTORY and OFFICE:

10th, 11th and Hebert Sts., St. Louis, Mo. U. S. A.

—MANUFACTURERS OF—

"National" Fire Hydrants,

Gate Valves, Extension Service and Valve Boxes, Yard Hydrants and Street Washers, Corporation Cocks and Goose Necks, Drinking Fountains, Etc., Etc., Etc.

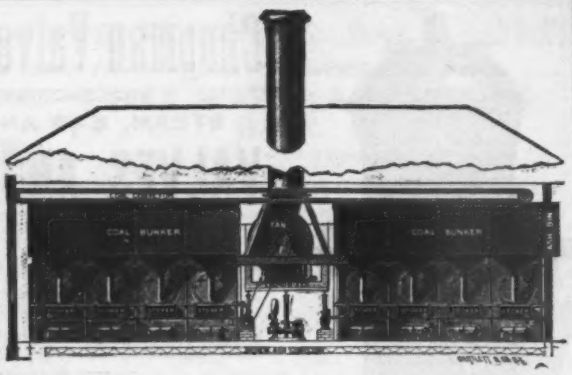
SEND FOR NEW CATALOGUE.

A question or two.

Have you coal to burn? Is its cost an important factor? Have you considered improved methods?

A word as to improvements.

When a radical advance is suddenly made in any art, it is usually broadly heralded, frequently overestimated, and always surrounded with more or less misinformation. When the art has advanced by gradual improvement, its development makes less impression. Its record takes the place of representation and its merits are more reliably known.



Burning coal to advantage.

Follow the practice from the time of inefficient boilers, cramped flues, low stacks, poor grates and worse settings, to the day of good boilers well set, with high stacks, and the various fuel and labor-saving attachments, from cleaning devices to damper regulators, and from shaking grates to mechanical stokers.

Something to think about.

A hot fire gets the most heat out of the coal.

When you have a hot fire under a boiler and a low stack temperature, your coal is making lots of heat and you are using it.

Don't be deceived into thinking your economy is good merely because the stack temperature is low.

Sometimes a high stack temperature is economical, because the greater economy of a hot fire more than makes up for the loss through the stack.

What to do.

Get the hottest fire you can out of your coal through perfect combustion. Get the lowest stack temperature possible by sending the heat into the water, not up the stack.

To do this, mechanical stoking is necessary in making a hot fire and keeping it hot all the time. An economizer and mechanical draft plant is necessary to utilize the surplus heat which the boiler will not take up.

To answer some possible questions.

The stoker feeds coal uniformly, burns it clean, and in fact is a first-class fireman who performs his duty without opening doors. The labor-saving in many cases exceeds the direct fuel saving.

The economizer puts the waste heat into the feed water, increasing its temperature 100 degrees or more, and every 10 degrees rise saves one per cent. of coal.

The mechanical draft supplies a sufficient draft independent of the stack, which may be merely high enough to clear the roof. The cost of the economizer and mechanical draft rarely exceeds that of a sufficient stack.

The economizer and mechanical draft go naturally together, though either may be used independent of the other. The economizer when used alone requires a high stack to give ample draft; the mechanical draft when used alone has the fan fitted with water boxes suitable for the high temperature resulting from absence of the economizer.

In general.

These things have advanced gradually until they have found wide application in plants from moderate sizes to the largest. Having made them a specialty, we suggest the above points for your consideration, and will supply more detailed information upon a knowledge of your conditions and requirements.

WESTINGHOUSE, CHURCH, KERR & CO.,

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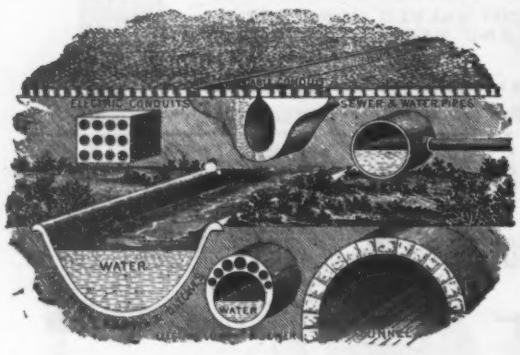

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See Advertisement on Front Cover.

Write for Circulars.

CAMERON STEAM PUMP

SIMPLE, RELIABLE, COMPACT, DURABLE

THE A.S.CAMERON STEAM PUMP WORKS

FOOT OF EAST 23RD ST. NEW YORK

FAITHFULNESS GUARANTEED.

FIDELITY & DEPOSIT CO. OF MARYLAND.

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Cash Resources June 29, 1895, $1,337,767.30

BONDS FURNISHED FOR CONTRACTORS.

Accepted by the United States Government as sole surety on Bonds of every description.

Becomes Surety on Bonds in all Judicial Proceedings; also on those for individuals occupying positions of trust.

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THE MISSISSIPPI RIVER

—FROM—

ST. LOUIS TO THE SEA.

Compiled and Prepared from the Official Reports of recent Surveys made by the United States Government, from the Reports of State Engineers and from other reliable sources.

By J. A. OCKERSON, C. E., M. Am. Soc. C. E., U. S. Ass't Engineer.
Assisted by CHAS. W. STEWART, U. S. Assistant Engineer.

These maps give a brief summary of the most important results of the surveys which have been carried on for several years, and form a complete atlas of the Mississippi River, embracing the adjacent topography and the physical characteristics of the stream and its banks.

41 Maps, Oblong, Paper Covers $3. Cloth, $4. Morocco $5.

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TRIBUNE BUILDING NEW YORK

THE DAVIS SYSTEM OF FILTRATION.

The usual simple reversal of current in Filter is ineffectual. To thoroughly cleanse filtering medium Scourers are essential. We guarantee satisfactory results. Contracts made for Filters or Filter Plants of any capacity.

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CHEMICAL AND PHYSICAL TESTS

of Metals, Cements and Materials of Construction and Technical Use.

CHAS. F. McKENNA, Ph. D.,

Successor to **Dr. Gideon E. Moore,** 221 Pearl St., New York City.

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The City Trust, Safe Deposit and Surety Company of Philadelphia, Pa.

927-929 CHESTNUT STREET, PHILADELPHIA.

INCORPORATED 1886.

Full Paid Capital, $500,000. Surplus Above Reserve $150,000

Accepted by all the departments of the National Government.

New England Agency, No. 66 State St., Boston, Mass.
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Pittsburg Agency, 113 Fourth ave., Pittsburg, Pa. Chicago Office, 307 "The Rookery."

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Ingots, Plates, Bars, Sheets, Wire, Tubes and Castings.

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For Testing Iron Specimens, Bridge Material, Chain, Cement, Wire Springs, Etc.

OLSEN'S TESTING MACHINES.

Hydraulic Presses, Accumulators, Gages and Pumps.

TINIUS OLSEN & CO., 500 N. 12th St., Phila., Pa.

Pocket Kodak

Size of Camera, 2¼ x 2⅞ x 3¾.
Size of Picture, 1½ x 2 in.
"One Button Does It, You Press It."

THE Pocket Kodak does everything photographic. It's a complete camera on a small scale. Made of aluminum and covered with fine leather. Perfect in workmanship, rich and dainty in finish.

Pocket Kodak, loaded for 12 exposures, . . $5.00
Developing and Printing Outfit, ... 1.50

EASTMAN KODAK CO.,

Sample photo and booklet for two 2-cent stamps. ROCHESTER, N. Y.

SEWERS, NYACK, N. Y.

Sealed proposals will be received by the Board of Sewer Commissioners of the village of Nyack, N. Y., until 2 o'clock, p. m., of Friday, January 24, 1896, for furnishing the materials and constructing a sewer system in said village.

The following is an approximate estimate of the materials and work on which bids will be received:

2,645 lin. ft. trenching, and backfilling 8 ft. to 10 ft.
65,520 lin. ft. trenching, and backfilling 10 ft. to 12 ft.
370 lin. ft. trenching, and backfilling 12 ft. to 14 ft.
1,310 lin. ft. trenching, and backfilling over 14 ft.
1,713 lin. ft. 12-in. sewer pipe furnished and laid.
2,778 lin. ft. 10-in. sewer pipe furnished and laid.
64,904 lin. ft. 8-in. sewer pipe furnished and laid.
450 lin. ft. 15-in. cast-iron pipe furnished and laid.
300 lin. ft. 18-in. cast-iron pipe furnished and laid.
1,000 lin. ft. 8-in. cast-iron pipe furnished and laid.
42 tees on 12-in. pipe.
61 " " 10 " "
1,428 " " 8 " "
103 manholes.
91 flush tanks.
86 inspection holes.
5,824 ft. B. M. spruce piling in place.
95 cu. yds. embankment.
2,000 sq. ft. dry paving.
115 in. cast-iron flexible joint.
118 " " " "
500 ft. rip-rap.

All bids must be made upon the printed forms to be obtained at the office of the Clerk of the Sewer Commissioners, on and after Jan. 6, 1896.

Each bid must be accompanied by a certified check, drawn to the order of the President of the Board of Sewer Commissioners, for the sum of $500.

Bids will be received for labor, material, and labor and material combined; the Board reserving the right to award the contract in whole or in part, or to reject any and all proposals.

Plans and specifications may be seen at the office of the Sewer Commissioners, in the village of Nyack, on and after Jan. 6, 1896.

CORNELIUS DE BAUN, President,
V. ACKERMAN,
E. H. MAYNARD,
E. B. SIPPELL,
JOHN P. SMITH,
} Commissioners.

EDWARD H. COLE, Clerk.
JAS. S. HARING, C. E., Engineer. 52-4t

OFFICE OF THE LIGHTHOUSE BOARD, Washington, D. C., Dec. 19, 1895.—Notice is hereby given that the date of opening the proposals for the construction and erection of the Mobile Ship Channel lights, Alabama, has been postponed from Thursday, Jan. 2, 1896, to Thursday, Jan. 16, 1896, and proposals will be received here until 12 o'clock, m., on the latter date. THE LIGHTHOUSE BOARD, Washington, D. C. 52-2t

For Other Proposals See Page XX.

EXTENSIBLE SEWER BRACE,
Guaranteed to be the Safest, Most Economical and Most Durable Sewer Brace in the Market.

Send a postal for our latest illustrated catalogue descriptive of this Brace.
THE DUHN MFG. CO., LIMITED.
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Columbus Office: 312 North High Street.

Quality Unsurpassed. Write for Prices.
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INCORPORATED.
Offices, 222 & 224 So. Third St., PHILADELPHIA.
MANUFACTURERS OF
Boiler Tubes, Wrought Iron Pipe and Fittings.
Sole Manufacturers of the Duggan Patent Adjustable Bracket.
Electric Railway and Light Pipe Poles a Specialty.

PROPOSALS FOR PLUMBING.

STATE OF NEW YORK—BINGHAMTON STATE HOSPITAL.

The trustees of the Binghamton State Hospital will receive proposals for the materials and work required for the plumbing in the main building on the hospital premises in accordance with plans and specifications prepared by Wm. Paul Gerhard, C. E., as follows:

Each proposal must be made in triplicate upon standard size paper, 8 × 10½, sealed and delivered to John Anderson, Secretary of the Board of Trustees of the Binghamton State Hospital, at his office, 100 Water street, Binghamton, N. Y., on or before 11 a. m., Jan. 3, 1896, endorsed, "Proposed for the materials and work required for the plumbing in the main building of the Binghamton State Hospital." Each proposal must be accompanied by bonds of two sureties, residents of the State of New York, each in the sum of $5,000. Said sureties are to guarantee that the bidder will execute a contract in case the work should be awarded to him and also that he shall perform the same faithfully.

Plans and specifications may be seen and information obtained at the office of Wm. Paul Gerhard, C. E., Consulting Engineer for Sanitary Works, No. 36 Union Square, East, New York City, or at the Binghamton State Hospital, Binghamton, N. Y.

The Board of Trustees reserves the right to reject any or all bids, as they may deem advisable in the interests of the State.

ALEXANDER CUMMING,
Chairman.
Binghamton, N. Y., Dec. 19, 1895. 52-1t

TREASURY DEPARTMENT, Office Supervising Architect, Washington, D. C., Dec. 23, 1895.—Sealed proposals will be received at this office until 2 o'clock, p. m., on the 20th day of January, 1896, and opened immediately thereafter, for all the labor and materials required for the interior finish, iron stairs, ceiling lights, plumbing, approaches, etc., for the U. S. Post Office., etc., building at Worcester, Mass., in accordance with the drawings and specification, copies of which may be had at this office or the office of the Superintendent at Worcester, Mass. Each bid must be accompanied by a certified check for one hundred and twenty-five dollars. The right is reserved to reject any or all bids, and to waive any defect or informality in any bid, should it be deemed in the interest of the Government to do so. All proposals received after the time stated for opening will be returned to the bidders. Proposals must be enclosed in envelopes sealed and marked, "Proposal for the interior finish, etc., for the U. S. Post Office, etc., building at Worcester, Mass.," and addressed to WM. MARTIN AIKEN, Supervising Architect. 52-2t

UTICA PIPE FOUNDRY CO.
Cast Iron Pipe and Specials for Water and Gas.
Also flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, etc. CHAS. MILLAR & SON, Selling Agents, Utica, N. Y. Lead Pipe and Plumbers' Materials.
Agents Akron Vitrified Sewer Pipe.

ESTABLISHED 1868. LAWRENCEVILLE CEMENT CO. WM. N. BEACH, President.
Manufacturers of BEACH'S ROSENDALE HYDRAULIC CEMENT
Superior to any other Rosendale Cement. It is FINELY GROUND, always UNIFORM and RELIABLE, unalterable in volume, and not liable to crack.
Address all communications to the Company,
Office: Havemeyer Building, Room 411, 26 Cortlandt Street, New York

PITTSBURGH TERRA COTTA LUMBER CO.
POROUS TERRA COTTA OR HARD TILE
FIRE PROOFING
Furnished and Constructed in all Parts of the United States.
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MUNICIPALITIES Having Contracts to Let should address
T. W. KINSER & SONS,
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SPECIALTIES: Sewers, Water-Works, Paving Railroads, Fills, Excavating and Masonry.

ENGINEERS . . .
MANUFACTURERS .
WATER-WORKS . .
SUPERINTENDENTS
and all others Steam Users . .
Should address us for information regarding the
Thomas Fuel Economizer and Smokeless Furnace.
Results Guaranteed.
Write for Circulars.
The Engineering Improvement Co.,
1239-1240, Monadnock
CHICAGO.

EXPLOSIVES
ARTHUR KIRK & SON
PITTSBURG, PA.
Powder, Dynamite, Rock Drills, Air Compressors, Rock Breakers, Safety Fuses, Electric Batteries, Miners' Squibs.

WATER-WORKS SUPPLIES.

ENGINEERS' OFFICE, WATER DEPARTMENT, BALTIMORE, Md., Dec. 24, 1895.

Sealed proposals, addressed to the Baltimore Water Board, City Hall, Baltimore, Md., will be received up to 12 o'clock m., Jan. 6, 1896, for the following material for the year 1896:

About 2,600 tons of cast-iron pipe, from 1¼ to 12 ins. in diameter; cast-iron pipe fittings, brass stops and ferrules, and special brass and iron castings, all from manufacturers only.

Also for 15 tons of Omaha pig lead, for jute packing and cypress lumber.

Specifications can be seen at this office.

The Board reserves the right to reject any or all bids.

By order of the Water Board.
WM. L. KENLY,
52-1t Acting Chief Engineer.

PUMPING ENGINES FOR SALE.

Owing to the fact that the City of Syracuse has constructed a gravity system of waterworks they offer for sale:

Two compound duplex condensing Dean engines, each 3,000,000 gallons capacity under head of 150 feet.

High pressure cylinder, 16 ins. diameter.
Low pressure cylinder, 30 " "
Pump cylinder, 17 " "
Stroke, 24 "

They are fitted with independent condensers and air-pumps, steam, water and vacuum gage, and everything pertaining to that class of engine. They are steam jacketed. The cylinders are all covered with hair felt and lagged well with best walnut lagging. Have been used as auxiliary engines for 10 years, and are in good condition.

Also two large Centrifugal Pumps, 10-inch outlet, capacity about 4,000,000 gallons each. Were used two months. For further information apply to W. R. HILL, Ch. Engr. and Supt., Syracuse, N. Y. 52-4t

For Other Proposals See Page XX.

CAST IRON OR STEEL PIPE.

Tenders will be received, by registered post only, addressed to the City Engineer, Toronto, up to 11 o'clock a. m. of Saturday, the 15th of February, 1896, for the supply and delivery of 2,350 ft. of steel or cast-iron pipe, 6 ft. in diameter, with the necessary flexible joints.

Specifications and plans may be seen at the office of the City Engineer, Toronto, on and after Wednesday, the 11th inst.

A deposit in the form of a marked cheque, payable to the order of the City Treasurer, for the sum of 2½ per cent. on the value of the work tendered for, must accompany each and every tender, otherwise they will not be entertained.

Tenders must bear the bona fide signatures of the contractor and his sureties or they will be ruled out as informal.

Lowest or any tender not necessarily accepted.

DANIEL LAMB,
Chairman Committee on Works.
Toronto, Ont., Dec. 3, 1895. 50-5t. e o w.

PUMPING STATION.

OFFICE BOARD COMMISSIONERS, ORLEANS LEVEE DISTRICT, MASONIC BUILDING, NEW ORLEANS, LA., Dec. 24, 1895.

Sealed proposals will be received at the office of this Board up to Tuesday, Feb. 11, 1896, at 1 p. m., for the erection of a pumping station, including machinery, foundations, buildings, etc., in conformity with plans and specifications in this office.

All bidders must deposit $1,000 in currency or certified check at the time of making bid, to insure signing of contract.

The board reserves the right to reject any and all bids. Other information as to location and character of work and terms of payment, as also blank forms of proposals may be obtained at the office of the Board.

FELIX J. DREYFOUS, President,
FRANK MARQUEZ, Secretary.
52-tf

Stick a Pin in This.

When you are ready to buy a sewing machine, your interests will be best served by selecting

THE WORLD RENOWNED WHITE.

You get a machine that is
Elegant in Finish,
Beautiful in Design,
Durable, Light Running,
A Ready Worker, and

The Best All-Around Sewer Made.

We want active dealers where we are not represented.

Address, for Liberal Terms,

WHITE SEWING MACHINE CO.,
CLEVELAND, OHIO.

For Sale by

WHITE SEWING MACHINE CO.,
22 Union Square, New York City.

$8 75 to ATLANTA, GA., and Return.

The Southern Railway, Piedmont Air Line, Eastern Office, 271 Broadway, announces a rate of $8.75, Washington to Atlanta and return. Tickets on sale Dec. 19 to 25 inclusive, good to return within five days. In addition to this low rate another rate of $14 is named. Tickets on sale Tuesday, Dec. 17, and daily from Dec. 19 to 25 inclusive, good to return 10 days. This low rate is given so that the rate is in reach of everyone to attend the Cotton States and International Exposition.

Advertise Contract Work
—IN—
Engineering News.

WATER-WORKS, POMONA, CAL.

OFFICE OF THE CITY CLERK,
POMONA, Cal., Dec. 9, 1895.

Sealed proposals on a cash basis will be received by the Board of Trustees of the City of Pomona, California, up to 7 o'clock p. m., of the 21st day of January, 1896, for furnishing the materials and constructing a system of water-works for said city of Pomona.

There will be required approximately about:

616 tons of 16-in. cast-iron pipe.
54 " " 12 " " " "
316 " " 8 " " " "
329 " " 6 " " " "
10 tons of special castings.
53 fire hydrants, and the following valves:
1 16-in.
1 12 "
11 8 "
24 6 "
79 4 "
35,664 ft. of No. 16, 4-in. single riveted steel pipe.
16 miles trenching and back filling.
1,000 ft. of 3-in. wrought-iron pipe

Bids will be received for furnishing any or all of the above materials, or for constructing the works complete, or for any part of the work, all material to be delivered f. o. b., Pomona.

Plans may be seen and specifications and form of contract and blank form of proposals procured from the City Clerk or City Engineer. All bids must be accompanied by a certified check payable to the order of the City Clerk for an amount equal to 5 per cent. of the amount of the bid. The Board reserves the right to reject any or all bids. All bids must be endorsed "Proposals for water-works," and addressed to

51-4t J. R. GARTHSIDE, City Clerk.

STREET SWEEPER WANTED.

RIVERSIDE, Cal., Dec. 10, 1895.

Notice is hereby given that sealed proposals will be received by the City Clerk of the city of Riverside, California, up to 2 o'clock p. m. of Tuesday, Jan. 7, 1896, and opened immediately thereafter, for the furnishing of a street sweeper of modern construction, and the delivery of the same, f. o. b. cars, at Riverside. Bidders will furnish their own specifications and circulars descriptive of the machine offered. The right to reject any or all bids is reserved.

W. W. PHELPS, City Clerk.
JAMES W. JOHNSON,
City Engineer. 51-3t.

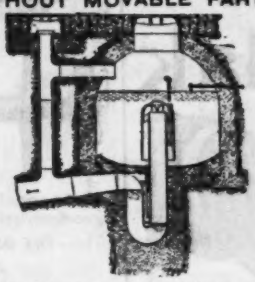
PROPOSALS FOR THE CONSTRUCTION OF A SEWER—OFFICE OF THE COMMISSIONERS OF THE DISTRICT OF COLUMBIA, WASHINGTON, D. C., Dec. 11, 1895.—Sealed proposals will be received at this office until 12 o'clock m., Saturday, Jan. 25, 1896, for constructing a main intercepting sewer from near the intersection of P street and Florida avenue to near the intersection of Twenty-fifth and Water streets northwest, with lateral branches on M and Twenty-seventh streets. Blank forms of proposals and specifications may be obtained at this office upon application therefor, together with all necessary information, and only bids upon these forms will be considered. The right is reserved to reject any and all bids or parts of bids. J. W. ROSS, GEORGE TRUESDELL, CHAS. F. POWELL, Commissioners, D. C. 51-6t

RHOADS-WILLIAMS AUTOMATIC SIPHON

. . . WITHOUT MOVABLE PARTS. . .

Our Siphons are Guaranteed to Work Perfectly.

Send to us for Catalogue and Prices.



Operates with Water Drop by Drop.

For Flushing SEWERS Use Them,

And Make Your Sewerage System Perfect.

FLUSH TANK COMPANY

173 LAKE ST., CHICAGO, Formerly Richmond, Ind.

ASPHALT PAVING.

Sealed proposals will be received by the Board of Public Works of the city of Niagara Falls, N. Y., up to 8 o'clock p. m Friday, Jan. 10, 1896, for paving a portion of Main street, in the second ward, and a portion of Ontario avenue, in the fourth ward, with sheet asphalt.

The total area to be paved is approximately 19,300 sq. yds., to be divided into three contracts, as follows:

Contract No. 6, 5,880 sq. yds.; No. 7, 3,320 sq. yds.; No. 8, 10,200 sq. yds.

Plans and specifications may be seen at the office of the City Engineer, 52 Gluck Building.

Bids will not be received unless made out on printed blanks, enclosed in printed envelopes furnished by the City Engineer, or if at al informal.

A certified check on a bank in good standing, payable to the City of Niagara Falls, without conditions, shall accompany each and every proposal in amounts as follows: Contract No. 6, $1,800; No. 7, $1,000; No. 8, $3,200.

The checks of the bidder or bidders to whom the contracts are awarded will be forfeited to the City of Niagara Falls in case of his or their failure to enter into contract and to furnish satisfactory bonds within 10 days after same is awarded.

The Board of Public Works reserves the right to reject any or all bids in whole or in part, or to award the contracts separately to several bidders.

Dated Niagara Falls, N. Y., December 21st, 1895.

O. W. CUTLER, Mayor.
A. SCHOELLKOPF,
M. B. BUTLER,
JOHN LENNON,
J. C. MORGAN,
Board of Public Works.
S. F. ARKUSH, City Clerk.
W. W. READ, City Engineer. 52-2t

PROPOSALS FOR ERECTION OF MEMORIAL HALL, West Point, N. Y.—Office of Post Quartermaster, West Point, N. Y., Dec. 14, 1895.—Sealed proposals in triplicate will be received at this office until noon, Monday, January 13, 1896, for the construction of a Memorial Hall. Plans can be seen and forms and specifications obtained at this office or at the office of Messrs. McKim, Mead & White, Architects, 160 Fifth avenue, New York City. The right is reserved to reject any and all proposals. J. B. BELLINGER, Captain and A. Q. M., U.S. Army. 51-3t

NOTICE TO STOCKHOLDERS.

The annual meeting of stockholders of The Engineering News Publishing Company will be held at the office of the company, Tribune Building, New York City, on Jan. 3, 1896, at 12 m.

CHARLES WHITNEY BAKER,
Secretary.
New York, Dec. 17, 1895. 51-2t

A Model Train New York & Florida Short Line Limited.

Commencing Sunday, Jan. 5, and daily thereafter the popular New York & Florida Short Line Limited will be resumed between New York and St. Augustine, via Pennsylvania, Southern, and Florida Central & Peninsular, leaving New York at 3:20 p. m. The train will be composed of Pullman's latest Compartment Cars, Sleeping, Dining, first-class Coach and Smoking Cars, from New York to St. Augustine. For grandeur and solid comfort there is nothing in the world that surpasses this train. The Compartment Car is a model of perfection. The entire train is most elaborately furnished, and the country through which the train travels is rich in magnificent scenery, and the one day which is consumed in the trip can be spent most advantageously in taking in the beauties of nature. The announcement of the new train several years ago was one of the great achievements of the Southern Railway "Piedmont Air Line," and the public are highly grateful and have and will continue to show their appreciation to the evident satisfaction of those instrumental in reducing the time between New York and Florida to a minimum. Excursion tickets south have been placed on sale at very low rates, and those contemplating taking a trip to the Sunny Lands should call on or address R. D. Carpenter, General Agent, Alex. S. Thweatt, Eastern Passenger Agent, 271 Broadway, New York.

DOUGLAS FIR (OREGON PINE).

Extraordinary sizes and lengths, suitable for Bridge Work, Trestles, False Work, Travelers, etc. Also YELLOW PINE TIMBER. Immediate shipment from yard stock in Wilmington by rail or water. Correspondence solicited.

Receivers of C. W. BUSH & SONS CO., Wilmington, Del.

MILLER AUTO

—FOR—

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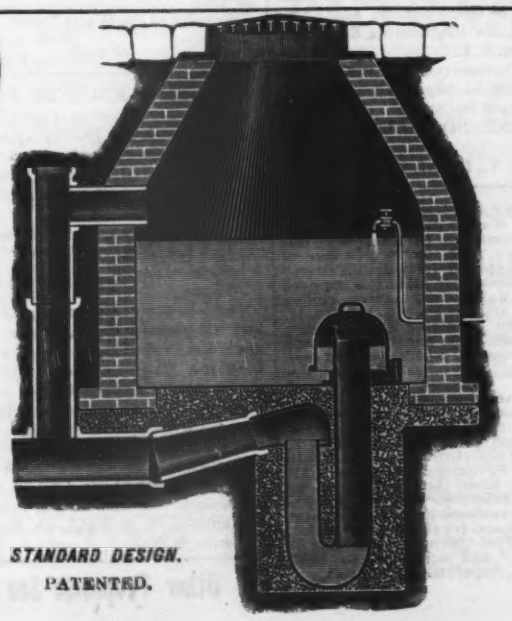

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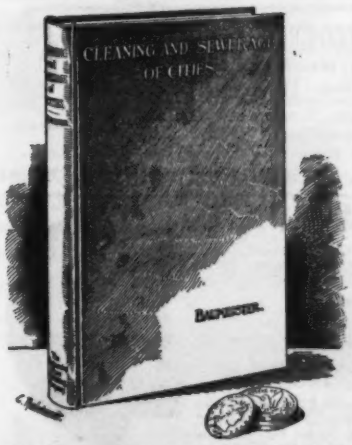

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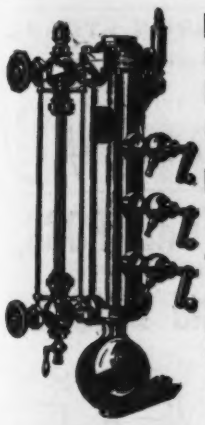

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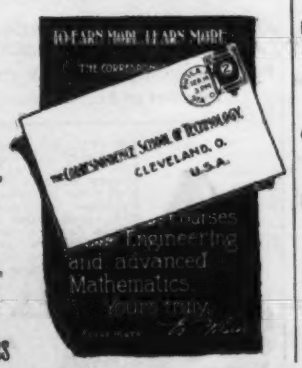

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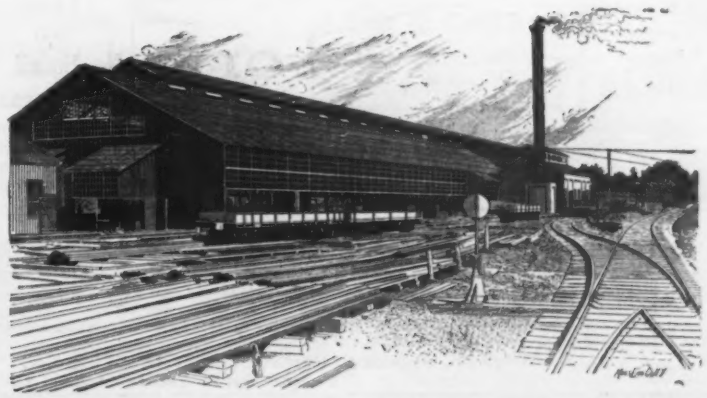

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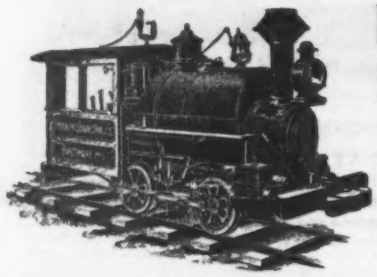

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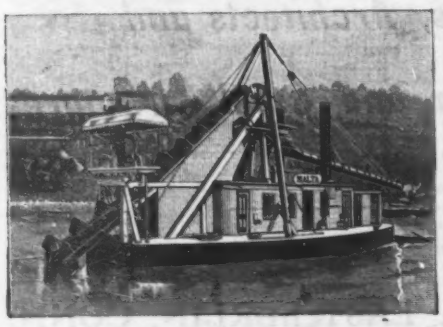

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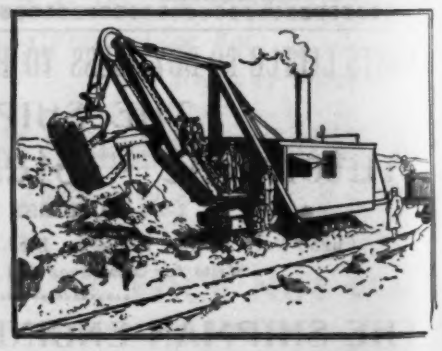

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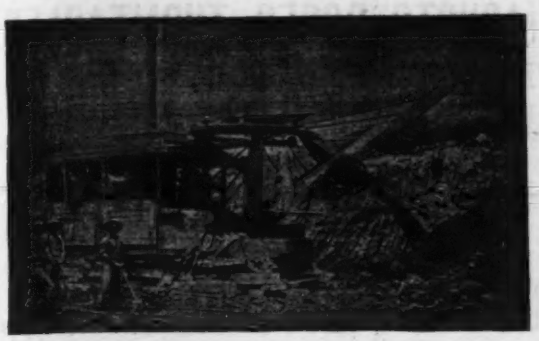

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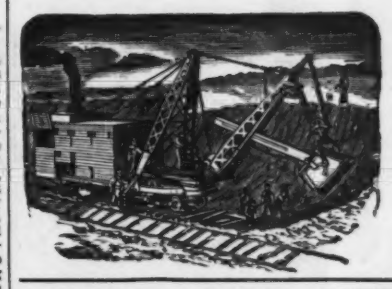

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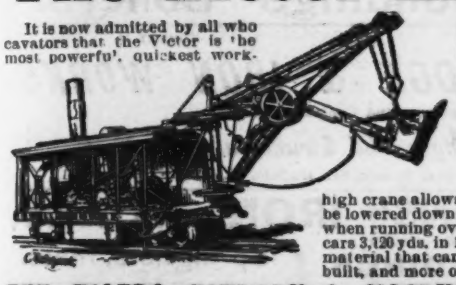

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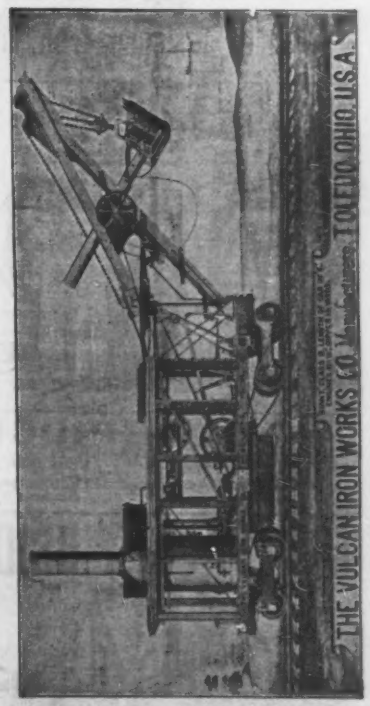

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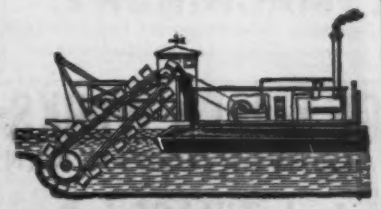

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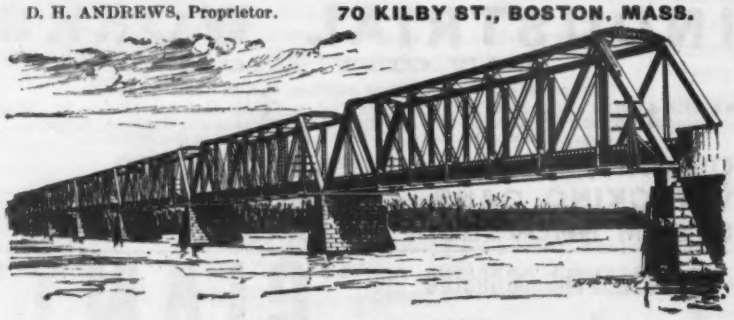

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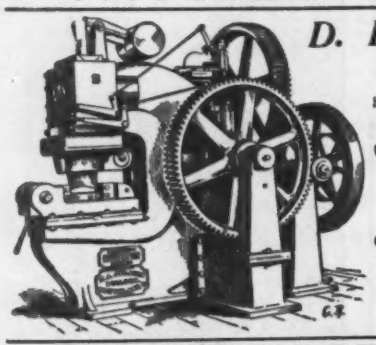

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